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SCHOOL RETROFIT PROGRAM (ENERSCHOOL) FINAL REPORT

MG NUMBER 13382

82.151
December, 1985

MANITOBA/CANADA CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

The availability of secure and affordable energy supplies is a subject of national concern. It is an accepted fact that our primary energy sources — oil and natural gas — are becoming less accessible and more costly. However, Canada is well-endowed with renewable and alternative resources that can provide a bridge into the future.

To this end, the governments of Manitoba and Canada entered into a Conservation and Renewable Energy Demonstration Agreement which was signed May 9, 1980 and terminated March 31, 1984. The Agreement was dedicated to the development and demonstration of conservation and renewable energy technologies. Equally cost-shared by the provincial and federal governments, the program had a total budget of $18-million.

The objectives of CREDA are:

- To develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy and/or use energy more efficiently.
- To develop broad public awareness of the potential of renewable energy and conservation technology.
- To provide opportunities for the commercial application of the technologies within Manitoba.
- To create economic spin-off benefits for manufacturing, industry and commerce.
- To create employment in new or existing energy-related industries.

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SUMMARY

Enerschool, the Manitoba School Retrofit Program, was initiated in 1983 by the Governments of Manitoba and Canada to test and demonstrate various energy conservation techniques in a number of schools throughout Manitoba. This report deals with the twenty schools selected and follows the initial energy audit and analysis reports of November 1983 and the 1984 summer implementation phase.

Each of the schools was allocated a capital cost allowance related to the physical size of the school. One Winnipeg school, Pierre Radisson Collegiate, and one northern school, Brochet, were selected as major retrofits and were permitted a high capital allowance. Program funding was shared by the federal and provincial governments and the school boards.

The program, which came to be known as the "Enerschool Program", had as its objectives the following:

1. provide technical and financial assistance to twenty schools in Manitoba who were prepared to implement and demonstrate energy conserving technologies.

2. prove the reliability and cost effectiveness of energy conservation retrofits.

3. develop public awareness and understanding of energy retrofit potential so it becomes generally accepted and widely adopted throughout Manitoba.

Contracts were awarded to W.L. Wardrop & Associates Ltd., for the eight Winnipeg schools, Underwood McLellan & Associates for the eight rural schools and Scouten, Mitchell, Sigurdson & Associates for the four northern schools. The consultants conducted detailed energy audits of each school to analyze and recommend methods and means for conserving energy.

The average estimated annual energy reduction for the eight Winnipeg schools was 17%, an amount which corresponds closely with the target figures of 20%. For the rural and northern schools the figures were 31% and 24% respectively.

Four of the Winnipeg schools surpassed the 20% target, whereas the other four, for various reasons, had marginal savings. The estimated cost savings range between $2,671 and $20,361 while overall payback periods range between 1.0 and 7.5 years. The average payback period was 4.3 years.

For the rural schools, the estimated cost savings range between $1,743 and $17,183 while overall payback periods range between 0.34 and 2.87 years. The average payback period was 1.14 years.

For the northern schools, the estimated cost savings range between $4,105 and $43,845 while overall payback periods range between 1.16 and 3.38 years. The average payback period was 2.06 years.

The following Retrofit Summaries highlight the retrofit costs, anticipated savings and estimated paybacks.

In the case of the two major retrofits the capital costs were $163,360 and consultant fees were $40,860. For the projected annual savings of $64,200 the simple payback period is 2.9 years.

The 18 schools minor retrofit program had a capital cost of $262,715 and $137,740 in consultant charges with potential savings of $153,215/year, which is equivalent to a simple payback period of 2.6 years.

This study has indicated that the payback period for sensible retrofits should be less than 5 years, regardless of the location of the school, or the size of the retrofit. Since the annual energy bill for 800 Manitoba schools is in excess of $18 million, the saving potential is in excess of $4.5 million/year.

RÉSUMÉ

Enerécole, le programme d'amélioration énergétique des écoles du Manitoba a été lancé par les gouvernements du Manitoba et du Canada en 1983. Le programme est destiné à expérimenter et éprouver différentes techniques de conservation d'énergie dans un certain nombre d'écoles manitobaines. Ce rapport traite des vingt écoles qui ont été choisies et fait suite aux premiers rapports parus en novembre 1983 sur l'analyse et la vérification des pertes d'énergie et à la mise en oeuvre du programme en été 1984.

On a accordé à chacune des écoles une allocation du coût en capital en fonction de la grandeur des locaux. Une école de Winnipeg, le collège Pierre Radisson et une autre, du Nord, l'école Brochet, ont fait l'objet de travaux d'amélioration énergétique plus importants et on leur a, en conséquence, consenti de plus grosses allocations du coût en capital. Les gouvernements provincial et fédéral ainsi que les commissions scolaires ont participé au financement du programme.

Le programme, qui a fini par être connu sous le nom de "Programme Enerécoles" avait pour but :

1. D'aider techniquement et financièrement les vingt écoles manitobaines qui ont accepté la mise en oeuvre et l'expérimentation de techniques de conservation d'énergie dans leur établissement.

2. De démontrer la fiabilité et la rentabilité des travaux d'amélioration énergétique.

3. De faire connaître et comprendre au public les avantages de l'amélioration énergétique afin que les Manitobains l'adoptent en grand nombre.

Les contrats ont été confiés à W.L. Wardrop & Associates Ltd. pour les huit écoles de Winnipeg, à Underwood McLellan & Associates pour les huit écoles rurales et à Scouten, Mitchell, Sigurdson & Associates pour les quatre écoles du Nord. Chaque école a été l'objet d'une vérification minutieuse en matière d'énergie par des conseillers chargés de trouver et d'analyser les meilleures méthodes de conservation d'énergie.

Dans les huit écoles de Winnipeg, l'économie d'énergie annuelle a été évaluée à 17 % en moyenne, chiffre qui se rapproche considérablement des 20 % qui avaient été estimés au départ. Quant aux écoles rurales et du Nord, les économies étaient respectivement de 31 % et 24 %.

Quatre des écoles de Winnipeg ont dépassé les 20 % visés, quant aux autres, elles n'ont obtenu, pour des raisons diverses, que de médiocres résultats. L'échelle des économies réalisées variait entre 2 671 $ et 20 361 $ tandis que les délais de récupération s'étalaient entre 1,0 et 7,5 ans. Les délais de récupération étaient en moyenne de 4,3 ans.

Pour les écoles rurales, l'échelle des économies réalisées variait entre 1 743 $ et 17 183 $ tandis que les délais de récupération s'étalaient entre 0,34 ans et 2,87 ans. Les délais de récupération étaient en moyenne de 1,14 ans.

Pour les écoles du Nord, l'échelle des économies réalisées variait entre 4 105 $ et 43 845 $ tandis que les délais de récupération étaient de 1,16 ans et 3,38 ans. Les délais de récupération étaient en moyenne de 2,06 ans.

Les résumés d'amélioration énergétique qui suivent illustrent les coûts de l'amélioration énergétique, les économies prévues et l'évaluation des délais de récupération.

Les allocations du coût en capital des deux écoles ayant fait l'objet de travaux d'amélioration énergétique plus importants se sont élevées à 163 360 $ et les honoraires des conseillers à 40 860 $. L'économie annuelle de 64 200 $ prévue correspond à un délai de récupération de 2,9 ans.

Les allocations du coût en capital des 18 autres écoles se sont élevées à 262 715 $ et les honoraires des conseillers à 137 740 $ mais avec une possibilité de réaliser des économies de 153 215 $ par an, ce qui équivaut à un délai de récupération de 2,6 ans.

L'étude démontre que des travaux d'amélioration énergétique appréciables, le délai de récupération ne doit pas être inférieur à 5 ans et, quelle que soit la situation géographique de l'école ou l'importance des travaux d'amélioration énergétique. Pour 800 écoles de la province, la facture annuelle d'énergie dépassant les 18 millions de dollars, les économies pourraient s'élever jusqu'à plus de 4,5 millions de dollars par an.

ENERSCHOOL PROGRAM

WINNIPEG SCHOOLS

RETROFIT SUMMARY

School	Annual Energy Consumption (before) (kWh)	Annual Energy Cost - $	Budgeted Retrofit Cost - $ (Actual)	Anticipated Savings* Energy Consumption (kWh)	Anticipated Savings* Value ($)	Budgeted payback (years)	Estimated Payback Period Using Actual Costs (Years)
Stevenson	1,145,697	23,067	15,840 (16,380)	216,194	5,093	3.11	3.21
Pierre Radisson Collegiate (Major Retrofit)	3,801,411	79,890	334,620 (75,727)	1,031,735	20,361	16.43	3.72
Guyot	1,890,000	48,621	12,210 (12,946)	117,060	3,926	3.11	3.29
Prince Edward	1,176,154	22,886	8,100 (7,764)	105,538	2,671	3.03	2.91
Springfield Junior High	1,176,000	34,715	15,765 (31,386)	40,000	3,970	3.97	7.91
Transcona Collegiate	2,285,450	45,508	20,010 (22,563)	301,630	7,330	2.73	3.07
Westview	1,419,269	26,785	11,055 (13,715)	466,279	7,645	1.45	1.79
H.C. Avery	989,600	30,254	9,000 (12,929)	243,000	7,905	1.14	1.64
TOTAL	13,883,581	311,726	426,600 (193,410)	2,521,436	58,901	7.24 (average)	3.28 (average)

* Interaction between individual items implemented prevents direct comparisons of total anticipated savings and the direct addition of implemented items.

Consultant fees not included.

ENERSCHOOL PROGRAM

RURAL SCHOOLS

RETROFIT SUMMARY

School	Annual Energy Consumption (before) (kWh)	Annual Energy Cost ($)	Budgeted Retrofit Cost - $ (Actual)	Anticipated Savings* Energy Consumption (kWh)	Anticipated Savings* Value ($)	Budgeted payback (years)	Estimated Payback Period Using Actual Costs (Years)
Centennial Elementary, Lac du Bonnet	662,366	19,999	4,575 (4,369)	226,556	8,908	0.51	0.49
Erickson Collegiate, Erickson	1,151,400	32,343	8,865 (12,782)	252,440	6,781	1.31	1.88
McCreary School, McCreary	1,098,760	38,305	11,880 (2,986)	121,798	8,942	1.33	0.33
Minitonas Intermediate, Minitonas	716,284	19,999	5,805 (14,746)	378,250	10,167	0.57	1.45
Neelin High	2,410,661	39,702	22,725 (14,495)	1,127,456	17,183	1.32	0.84
Roseau Valley, Dominion City	1,603,336	28,164	15,105 (15,480)	785,475	11,983	1.26	1.29
St. Joachim - La Broquerie	586,566	17,255	6,495 (6,446)	54,552	1,743	3.73	3.70
Berens River School - Berens River	1,701,817	97,101	12,510 (13,666)	426,155	16,921	0.74	0.81
TOTAL	9,931,190	292,868	87,960 (84,970)	3,372,682	82,628	1.06 (average)	1.03 (average)

Consultant fees not included.

ENERSCHOOL PROGRAM

NORTHERN SCHOOLS

RETROFIT SUMMARY

School	Annual Energy Consumption (before) (kWh)	Annual Energy Cost ($)	Budgeted Retrofit Cost - $ (Actual)	Anticipated Savings* Energy Consumption (kWh)	Anticipated Savings* Value ($)	Budgeted payback (years)	Estimated Payback Period Using Actual Costs (Years)
Leaf Rapids Education Centre	1,879,167	47,065	24,210 (26,560)	432,222	10,160	2.38	2.61
Ruth Betts School, Flin Flon	1,353,611	41,105	17,490 (19,597)	135,778	4,105	4.26	3.07
Brochet School (Major Retrofit)	1,165,556	93,055	110,700 (87,634)	489,445	43,845	2.52	1.99
Scott Bateman Junior High, The Pas	934,722	42,309	16,395 (13,904)	196,389	8,841	1.85	1.57
TOTAL	5,333,056	223,534	168,795 (147,695)	1,253,834	66,951	2.52 (average)	2.20 (average)

Consultant fees not included.

INTRODUCTION

In 1983, the Governments of Manitoba and Canada initiated the School Retrofit Program (Enerschool). Technical and financial assistance was provided for testing and demonstrating various energy conservation techniques in a number of schools throughout Manitoba. Eight urban, eight rural and four northern facilities were chosen to participate, with the intent that the selected locations would provide a representative cross-section of similar facilities nation-wide.

The schools selected were divided into two groups; major and minor retrofits. Major retrofits included a capital cost retrofit allowance of $47.30/square metre, whereas the minor retrofit schools had a cost allowance of $3.55/square metre. Enerschool funding was provided under the Manitoba/Canada Conservation and Renewable Energy Demonstration Agreement (CREDA). CREDA provided two-thirds of all project costs. The balance was assumed by the respective participating school divisions.

The consultants undertook an inspection tour of the facilities and prepared individual audit reports for each school. Each report included a list of recommended retrofit options which satisfied a predetermined capital cost allowance and payback criteria, as well as other viable retrofit options which were available, regardless of constraints. Specific retrofit options selected from the reports were implemented during the summer of 1984 following preparation of contract tender specifications.

In the following sections of this report we have addressed each school individually, briefly describing its construction and features, the retrofit measures investigated, recommended and implemented, as well as estimated capital costs and cost savings. In addition, the variations in energy reduction as observed in the schools is addressed.

With the completion of the energy conservation seminar in early April, 1984, and completion of the implementation phase, the program was successful in fulfilling all of its purposes.

The School Retrofit Program was conducted in six stages.

The first stage involved preparation of energy analysis studies for each school, which identified appropriate energy retrofit projects, based on an analysis of design and operating conditions, energy and cost savings, capital costs and simple payback periods. Recommendations were examined under three main headings - Architectural Options, Mechanical Options and Electrical Options.

The second stage was a review of the report and selection of the options to be implemented by the steering committee and school boards.

The third stage was to participate in an energy conservation forum presented to the annual meeting of the Manitoba Association of School Trustees.

The fourth stage involved implementation of the selected options with the major work carried out under contract in accordance with documents prepared by the consultants. Other portions of work were administered by the schools with guidance from the consultants.

The fifth stage was a series of 1 day seminars held throughout the province. These seminars were presented to various levels of school personnel with the intention of promoting energy conservation by illustrating the findings of the Enerschool program.

The sixth stage was preparation of the final report.

Under the terms of the Conservation and Renewable Energy Demonstration Agreement (CREDA) funding for the project, including consultant costs, was equally cost shared by the provincial and federal governments and the proponents in an effort to develop and demonstrate conservation and renewable energy technologies.

The energy analysis study for each school facility included analysis of all aspects of building construction, electrical and mechanical systems, building occupancy, and operating procedures. The facilities were also reviewed to determine their conformance with applicable codes and standards. The identification of energy losses due to air leakage, inefficient lighting systems, lack of insulation, inefficient electrical power factor, and mechanical systems were made with an indication of their impact on the total energy budget of each facility. Retrofit options for the facilities were analyzed to outline the design and operating considerations, to estimate the energy and cost savings, and the costs and payback period of each option.

This report includes a summary of the retrofit options selected by each school and a table listing the total capital expenditure and percent cost saving for the selected retrofit options only in each school listing.

GENERAL CONCLUSIONS & RECOMMENDATIONS

The study and retrofit of twenty schools in Manitoba has shown that excellent potential for energy conservation exists. There are approximately 800 schools in Manitoba. Extrapolating the results of this study to this level indicates an energy saving potential of some 214,000 annual gigajoules (GJ), and a potential energy cost savings of approximately $4.5 million. This, in turn, could generate construction activity with capital expenditures that could exceed $12 million.

The payback period for retrofit work was on the average less than 5 years, which indicates that even without government funding school divisions could consider borrowing as a means of financing energy retrofit programs.

A substantial portion of energy costs in schools can result from improper operation and maintenance of the building and its systems. A seminar manual, which was prepared as part of the total retrofit program, identifies and describes various means by which energy use can be reduced via operational changes and proper maintenance. The seminar manual(1) should be obtained and read in conjunction with this report. As a general guideline, it is suggested that stickers and posters should be utilized to remind people to switch off lights and equipment, close doors, etc. whenever possible.

It is extremely important that the procedures, entitled "The Energy Conservation Process" in the seminar manual, are adhered to whenever a school is considering embarking on a retrofit program. It is equally as important that a qualified consultant is hired to perform the necessary audit and evaluation.

A brief general summary of recommended energy conservation techniques and potential savings follows.

1. RETROFIT OPTIONS

Each school was studied in detail in order to arrive at a site specific retrofit program. Various factors, such as building and HVAC system design, age, location, fuel choice and cost, will affect the cost effectiveness of any retrofit option. Therefore each school will have its own set of effective retrofit options. The retrofit options which are presented in the following tables are a summary of items recommended in the twenty schools studied; all items do not apply to every school.

The retrofit options are presented as follows:

- Architectural Options
- Mechanical Options
- Electrical Options

(1) Enerschool, Energy Conservation for Manitoba Schools, April, 1984. Manual available from Manitoba Energy and Mines

Ranges given for costs and payback periods are intended to give a general indication only and can vary considerably from facility to facility. In all cases, when schools are contemplating any of the measures listed, these should be carefully analyzed by competent individuals prior to implementation.

1.1 Architectural Options - Building

Control of air infiltration and exfiltration and heat transfer through the building envelope is important to reduce energy demand. A summary of architectural options that can be considered is provided in Table A.

Sealing of building openings, weatherstripping and caulking windows and doors, adjustment of fit at entrances, backdraft dampers or exhaust fans, etc. produce excellent savings. A program of spot checking and upgrading should be carried out continuously, with a special effort prior to each heating season.

It is important to seal, as well as possible, all cracks in the building shell, weatherstrip at entrances and vehicle doors even in an unheated area.

When consideration is being given to replacing doors, good quality insulated doors should be utilized. Door replacement is generally not economical unless replacement is being considered for reasons other than energy conservation; however, if doors are in poor condition and cannot be weatherstripped properly, substantial savings may result.

Entranceways are a common source of heat loss. Well designed vestibules can be effective on frequently used entries.

Windows should, at the discretion of school staff, be blanked off with insulated, aesthetically pleasing panels.

Insulating of walls and ceilings generally is not economically feasible unless the existing level is quite low. An important factor to be considered is the type of heating system in the building. Where fuel costs are extraordinarily high, such as in remote locations, higher insulation levels may be warranted. Whenever building modifications are being considered, insulation levels should be increased to the current standard.

A qualified consultant should be hired to assess the feasibility and method of adding insulation.

TABLE A

Architectural Options

	Cost Range ($)	Range of Payback Period (Years)	Comments
Improve, repair or replace weatherstripping and sealing at doors, windows and the building openings	1,000 to 2,500	1.5 to 6	Excellent energy retrofit, annual checks and repairs are required to ensure continuing savings.
Replace existing uninsulated doors in poor condition with new insulated steel doors - heated areas only.	400+	14+	When consideration is being given to replacing doors, good quality insulated doors should be installed.
Add insulation to building walls, ceilings, etc.	500+	3+	Payback range is dependent upon level of existing insulation, cost depends on area to be insulated.
Replace single glazed windows with double glazed.	500+	20+	Payback periods do not warrant replacement. However, when upgrading, double glazed should be used.
Replace windows with insulated in-fill panels	100+	5+	Usually a good investment when windows are not required for daylight contribution.

Operating Procedures

1.2 Mechanical Systems:

Some of the more cost effective mechanical options are listed in Table B.

Night setback of building temperatures provides an excellent means of reducing energy costs. While this can be done manually, it is suggested that the appropriate thermostats be purchased so that night set back is accomplished automatically.

Switching off mechanical systems that operate unnecessarily during unoccupied periods is a simple means of reducing energy costs. This can be done manually or can be accomplished automatically by 7-day time clocks or computers.

Reducing the amount of outside air brought into the school through ventilation units is a good way of reducing energy costs. This can easily be accomplished by raising the mixed air temperature and does not generally require a high capital cost, if any.

Air handling units and exhaust fans serving areas that are occupied on an irregular basis, such as gymnasiums and washrooms, should be controlled by manual reset timers. Manual reset timers allow units to operate for a specified period of time after which they are shut off automatically. These timers are generally very cost effective.

Resetting the temperature of a hot water boiler in relationship to the outdoor temperature can result in an effective way of reducing energy consumption. This retrofit requires careful evaluation on an individual basis.

1.2.1 Control of Mechanical Systems:

Proper operation of controls for heating, ventilation and air conditioning equipment was reinstated. In some schools this included the installation of new controls. Typical control modifications and installations include:

- change time clock settings
- change thermostat settings
- adjust mixed air controllers
- provide night set back
- install outdoor reset
- install manual reset timers
- provide operating guidelines

TABLE B
Mechanical Options

	Cost Range ($)	Range of Payback Period (Years)	Comments
Turn off ventilation equipment during mechanical periods.	200 to 500	1 to 3	Not to be done with equipment that provides space heating.
Install manual reset timers to control ventilation equipment on an as required basis during occupied periods.	150 to 300	2 to 4	Depends on units.
Install outdoor reset for hot water heating boilers.	250 to 400	1+	Price per boiler.
Install timer to control washroom exhaust fan, wire into washroom light switch.	200+	2+	Depends on number of fans.
Install locking cover over thermostat.	20+		Payback period should be within approximately 1 year.
Reduce outside air quantities by increasing mixed air temperatures.			Code requirements for ventilation should still be met.
Install ceiling fans.			Should be installed in areas of stratification.
Repair or replace backdraft dampers for exhaust fans and ensure a tight seal on closing.	200 to 500	2	
Install good sealing dampers on ventilation units.	50 to 2,500	1+	This is especially important to prevent leakage of outdoor air which must be heated.
Install night thermostat - to allow setback of temperatures at night.	100+	1+	Depends on number and type of thermostats, type of heating system.
Install insulated covers over wall exhausters in low use areas.	250+	6+	Depends on number of fans.
Operating Procedures			

1.3 Electrical Systems:

Summary of Electrical Options is given in Table C.

Power factor correction for electrical services is an excellent cost savings retrofit item, and generally should be investigated in all schools.

Excellent potential exists for reduction in electricity costs when a building is heated electrically. This is accomplished by interlocking the heating system with other electrical loads.

Lighting modifications consist of switching lights off when not required to replacing an entire lighting system. Incandescent lighting can be replaced by fluorescent lighting in office and classroom areas, and metal halide in gymnasiums.

Energy costs for the schools may further be decreased by considering some of the retrofit options of this report that may be economically feasible in the future. Finally, a significant decrease in energy consumption can be achieved by improving maintenance and operating procedures.

2. POTENTIAL SAVINGS

The potential savings were estimated for the retrofit options implemented at all of the schools. The following tables summarize savings totals for the three regions for various groups of retrofit options. For more detail the reader should consult the tables for individual schools that are contained in the subsequent section.

2.1 Building: Air Leakage

Annual savings were established as a result of reduction in air leakage in at least the following ways:

- caulking and weatherstripping doors and windows
- adjusting fit at entrance
- sealing of fresh air intake dampers and exhaust fan backdraft dampers
- sealing of building openings

TABLE C

Electrical Options

	Cost Range ($)	Range of Payback Period (Years)	Comments
Replace incandescent lighting with fluorescent in corridors and locker rooms, etc.	500+	2+	Cost depends on number of fixtures, ease of installation. Payback period depends on light levels required (ie. if light level is very high, then less fixtures are required and better payback results).
Replace incandescent lighting in classrooms with fluorescent.	1,500+	6+	Cost shown is for 1 classroom.
Convert gymnasium lighting from incandescent to metal halide.	5,000+	2+	Cost shown could vary depending on gym size. Payback periods should be close to 2 years.
Install power factor correction.	1,200+	1+	Excellent retrofit option if power factor is presently low.
Install peak demand limiting devices or demand controller.	6,000 to 15,000	3 - 6	Good potentital in buildings which have electric water heaters electric heating, larger parking lots.

Operating Procedures.

The estimated annual savings and capital costs for the three regions studied are:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Winnipeg	75,615	6,079	12.4
Rural	963	8,072	0.1
Northern	10,000	8,050	1.2

The estimated short overall simple payback period figures make eliminating air leakage an excellent retrofit alternative.

2.2 Mechanical System Control

The estimated annual savings and capital costs for the three regions studied are:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Winnipeg	59,940	35,601	1.7
Rural	25,935	66,612	0.4
Northern	31,850	12,800	2.5

The overall estimated simple payback period figures indicate that control of mechanical systems should be examined in all schools.

2.3 Ventilation Air:

Reducing outside air quantities to recommended levels reduces the energy consumption to heat ventilation air.

The estimated annual savings and capital costs for the three regions studied are:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Winnipeg	49,800	25,677	1.9
Rural	250	516	0.5
Northern	5,150	1,050	4.9

2.4 Inefficient Oil Burners:

Due to the high capital costs involved, oil burners were replaced with new high efficiency burners at Brochet School only. However, simple payback periods of about one year make replacement of inefficient oil burners a very attractive retrofit option for any school with oil heating systems. The estimated annual savings and capital costs for the northern regions studied is:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Northern	15,000	13,000	1.2

2.5 Lack of Insulation in Walls and Ceilings:

The economic feasibility of adding insulation is very dependent upon the existing insulation level and the type of fuel used in the heating system in the building. Insulation levels in the facilities surveyed range from fair to good. A competent consultant should be hired to analyze the feasibility of adding insulation. The estimated annual savings and capital costs for the three regions studied are:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Winnipeg	4,000	768	5.2
Rural	5,000	2,400	2.1
Northern	10,000	900	11.1

2.6 Inefficient Lighting Systems:

Lighting systems, in general, were upgraded consistent with IES (Illuminating Engineering Society) guidelines. It is generally found to be economical to convert from incandescent lighting to a more efficient light source, such as fluorescent and metal halide. The estimated annual savings and capital costs for the three regions studied are:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Winnipeg	28,690	4,846	5.9
Rural	3,912	3,700	1.1
Northern	38,825	13,204	2.9

2.7 Electrical Control Systems:

Control devices to limit electrical demand and consumption were implemented in some schools. The controllers cycle loads to prevent numerous loads from coming on line simultaneously. For example, in one school the heating system was cycled and in another school the parking lot plugs were cycled. The estimated annual savings and capital costs for the three regions studied are:

	Estimated Capital Cost ($)	Estimated Annual Savings ($)	Estimated Overall Simple Payback (Years)
Winnipeg	14,870	6,434	2.3
Rural	19,200	8,392	2.3
Northern	21,000	5,408	3.9

2.8 Power Factor Correction:

Due to cost considerations power factor correction was only implemented in one of the schools studied. Studies, however, suggest further investigation of this retrofit option. Power factor correction with a short payback period generally represents an excellent opportunity for energy cost reduction.

WINNIPEG SCHOOLS

STEVENSON SCHOOL

STEVENSON SCHOOL - SCHOOL DIVISION NO. 2

Building Description

Stevenson School was built during 1969-1970 for use as a Junior High School. In 1982, the school was converted for use as an elementary school. The school is a two-level structure, with crawl space, having a gross floor area of 4,461 square metres. The school features a library, kindergarten, music rooms and gymnasium, in addition to the usual classroom, staff and mechanical room areas.

Construction consists of concrete block walls on structural concrete slabs and with built-up roofing on precast concrete beams. Windows are double glazed with aluminum frames, and doors are of the insulated steel variety.

Low pressure steam is utilized in the perimeter radiation units on the second floor and vestibules and hot air terminal reheats in the remainder of the school to provide heating. Ventilation is provided by the hot air distribution system supplemented by local exhaust fans. Air conditioning of the classrooms is accomplished through the air distribution system. The gymnasium is heated and ventilated with a hot air system similar to the main floor classroom system. Domestic hot water is provided by an electric hot water tank.

The classroom and assembly areas utilize strip-mounted fluorescent fixtures as primary lighting. The main floor corridors and lounge areas are illuminated using incandescent surface fixtures with 150W lamps. The second floor corridors utilize indirect fluorescent lighting. Lighting in the gymnasium consists of mercury vapour lamps.

Energy Consumption

The annual energy consumption for the calendar year 1982 was:

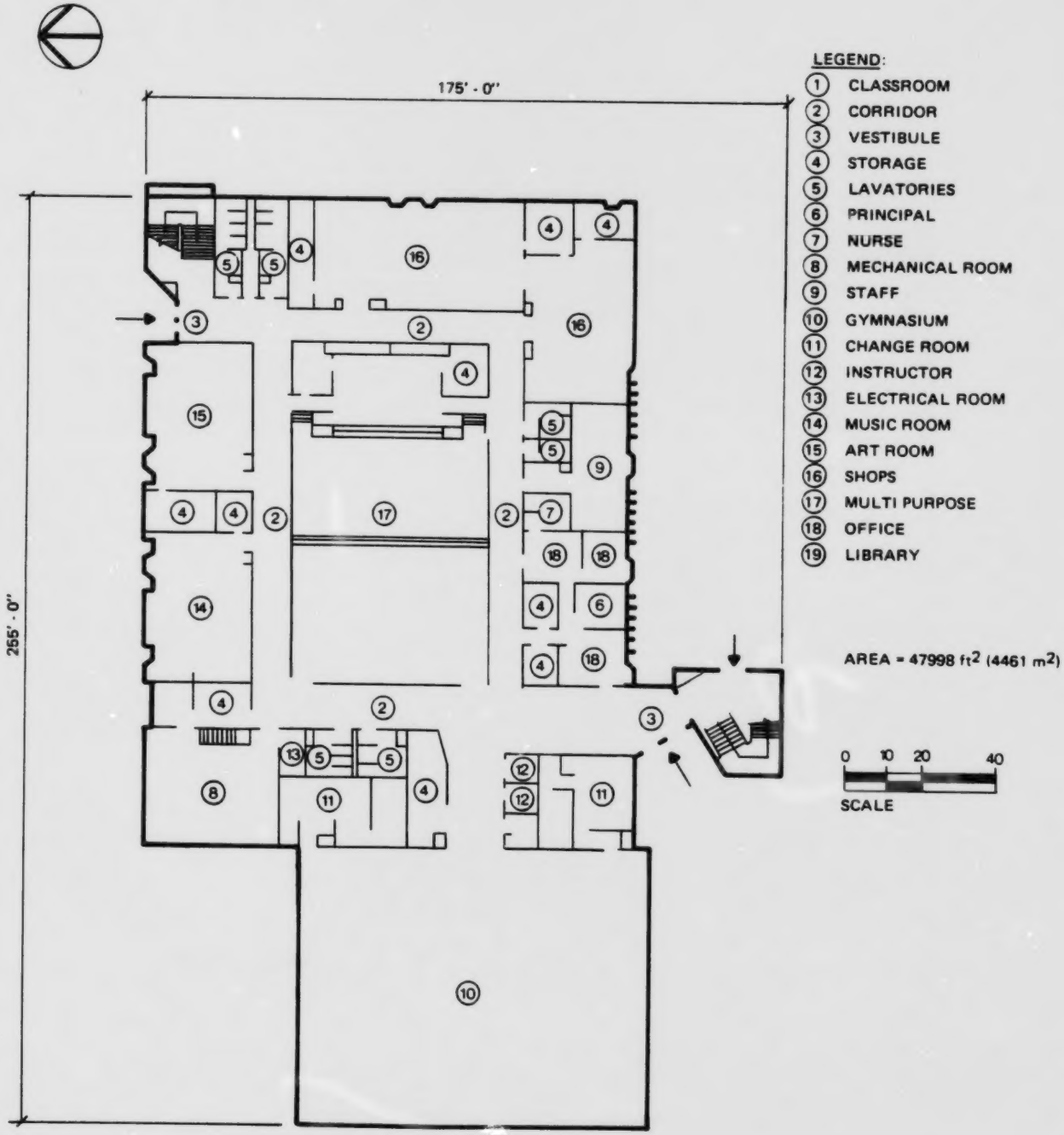
Natural Gas	823,857 kWh
Electricity	321,849 kWh
Total Annual Consumption	1,145,706 kWh
Energy Index	257 kWh/m^2

Retrofit Measures

Tables 1 and 2 on the following pages represent all retrofit measures investigated at this school. Table 1 shows the recommended retrofit options as they were addressed in the Enerschool Audit and Analysis Report on November, 1983. The recommended options are within the allocated budget for this school and they all have a payback period of five years or less. Table 2 lists all other options investigated but which are over budget and have a greater than five year payback period.

Of the eighteen items investigated and reported on, eleven were selected for implementation. These eleven items are identified on Tables 1 and 2 with an asterisk. Items 5, 6, 7 and 8 on Table 2 express implementation costs and cost savings per individual steam trap. For purposes of this report, we have assumed that five 12 mm, three 20 mm, two 25 mm and one 30 mm steam traps were repaired or replaced during the implementation phase.

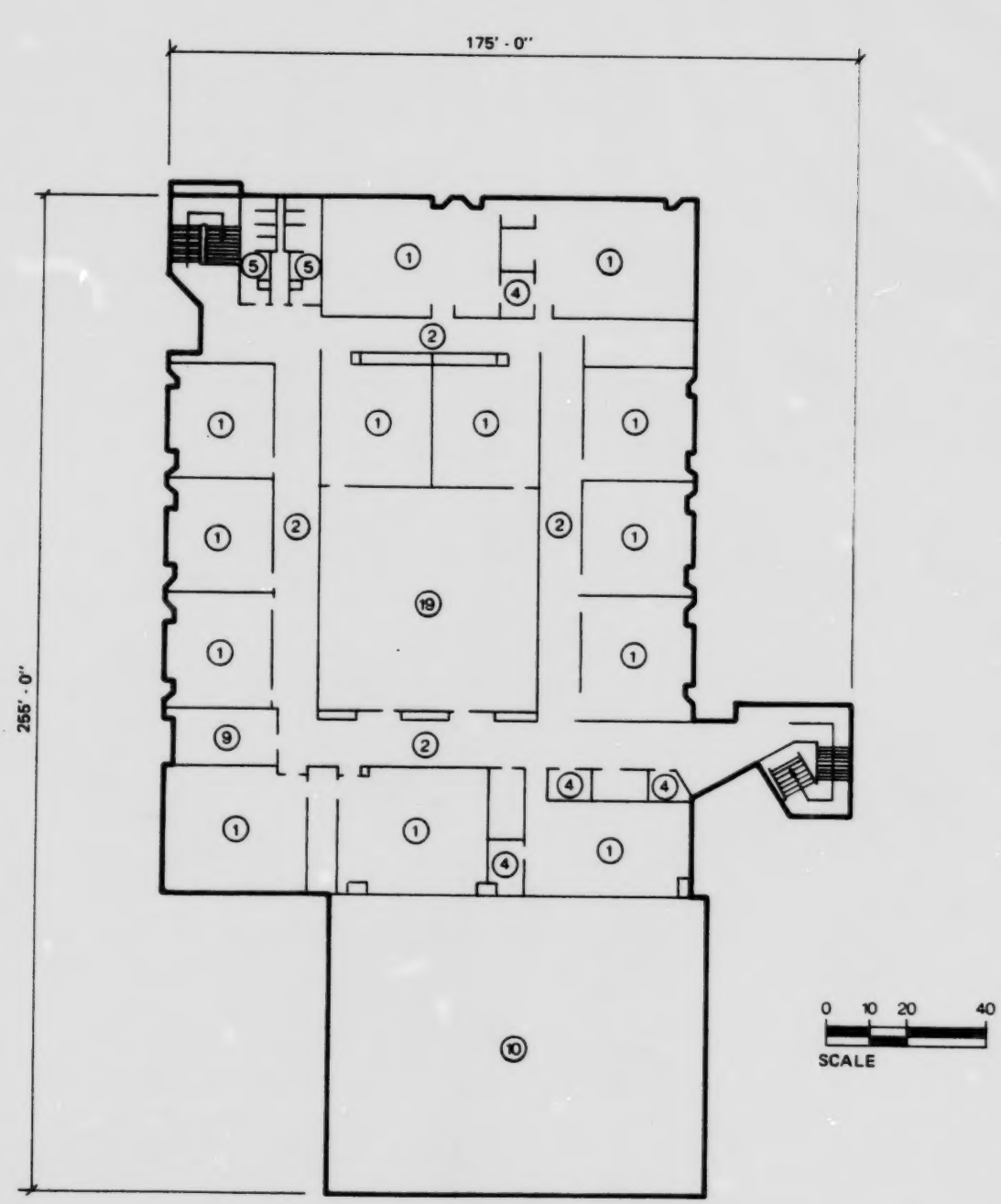
The estimated annual energy consumption reduction is 316,190 kWh (27.6%), resulting in an annual cost saving of $5,093. The estimated retrofit cost of $15,205 provides an estimated average payback period of 3.0 years.



MAIN FLOOR PLAN

ENERSCHOOL PROGRAM
STEVENSON SCHOOL, WINNIPEG

FIGURE 1a



2ND FLOOR PLAN

ENERSCHOOL PROGRAM
STEVENSON SCHOOL, WINNIPEG

FIGURE 1b

TABLE 1

STEVENSON SCHOOL

RECOMMENDED RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Windows	Leaking	Repaired	Weather Stripping	10,210	168	0	0
*2.	Fresh Air Damper	4.74 m^3/s	2.78 m^3/s	Readjust position of fresh air damper	90,634 4,532	1,679	100	0.1
*3.	Mixed Air Temp.	13°C	18°C	Reset mixed air temp.	49,875	819	100	0.1
4.	Ventilation Temp. Control	Fan running	Fan not running 7 AM to 9 PM	Fan does not run on night cycle when OA is above 4.5°C	28,360	466	100	0.2
*5.	12 mm Steam Traps	May be leaking	Repair	Repair trap or replace	11,880	195 ea.	60 ea.	0.3
*6.	20 mm Steam Traps	May be leaking	Repair	Repair trap or replace	14,200	233 ea.	40 ea.	0.4
*7.	25 mm Steam Traps	May be leaking	Repair	Repair trap or replace	14,945	245 ea.	125 ea.	0.5
*8.	30 mm Steam Traps	May be leaking	Repair	Repair trap or replace	15,700	258 ea.	180 ea.	0.7
*9.	Reduce Washroom Air Exhaust	2.78 m^3/s	1.77 m^3/s	Reduce rpm of the fans	46,700 2,335	865	700	0.8
*10.	Parking Lot Plugs	No control	Day/night and cycle time	Install 7 day timer and cycle timer	10,730	451	890	2.0
*11.	Exhaust System	Manual Control	Automatic	Install 7 day timer	18,412	302	625	2.1
*12.	Entrance Doors	Leaking	Repair	Install weather-stripping	18,400	302	1,300	4.3
	* ITEMS IMPLEMENTED					5,983	4,220	0.7

Note: Items 5 to 8 are per trap. The total cost savings and capital cost expressed in the text are based on 5-12 mm, 3-20 mm, 2-25 mm and 1-30 mm traps being repaired or replaced.

TABLE 2

STEVENSON SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Corridor Lights	Incandescent	Fluorescent	Replace corridor lights	26,422	1,697	10,640	6.3
2.	Condensate Piping	No insulation	12 mm Insulation	Insulate all condensate piping and tanks	33,530	550	8,000	14.5
3.	Condensate Piping	No insulation	15 mm Insulation	Insulate all condensate piping and tanks	36,280	596	11,500	19.2
4.	Condensate Piping and Tanks	No insulation	50 mm Insulation	Insulate all condensate piping and tanks	38,970	640	16,500	29.8
5.	Gymnasium Ceiling	RSI=1.92	RSI=2.54	Spray deck 25 mm Insulation	15,370	252	15,800	63
6.	School Roof	RSI=1.92	RSI=3.67	Increase roof insulation by 50 mm.	86,190	1,416	96,700	68

* ITEMS IMPLEMENTED

PIERRE RADISSON COLLEGIATE

PIERRE RADISSON COLLEGIATE - SCHOOL DIVISION NO. 4

Building Description

Pierre Radisson Collegiate was constructed in two stages; the original school in 1968, and a classroom and shop addition in 1978. The school is a two-level structure, with crawl space and part basement, having a gross floor area of 7,068 square metres. Besides the classrooms, the school has special use areas such as Materials Resource Centre, Gymnasium, Kitchen, Music Rooms, Automotive Shops, Arts, Staff and Student Dining Rooms, Sewing, Laundry and Food Classrooms, as well as the usual service areas such as storage, mechanical and boiler rooms, and janitor areas.

The building construction is typically concrete block walls with cast-in-place concrete floors with metal roof deck and steel joists and trusses. Windows are double glazed with aluminum frames and doors are insulated steel.

Heating of the building is provided by eight natural gas hot water boilers through a terminal reheat system. Vestibules and corridors are provided with perimeter heating. Ventilation is provided by a number of units, including high and low velocity units serving the classroom portions, gymnasium ventilation units, automotive shop ventilation units, kitchen ventilation, as well as numerous individual exhaust fans. All classroom areas of the school are provided with summertime air conditioning. Domestic hot water is provided by a natural gas boiler and a storage tank system.

All classroom, hallway and vestibule lighting consists of two or four-lamp fluorescent fixtues. Gymnasium lighting is by 400 W mercury vapour lamps.

Energy Consumption

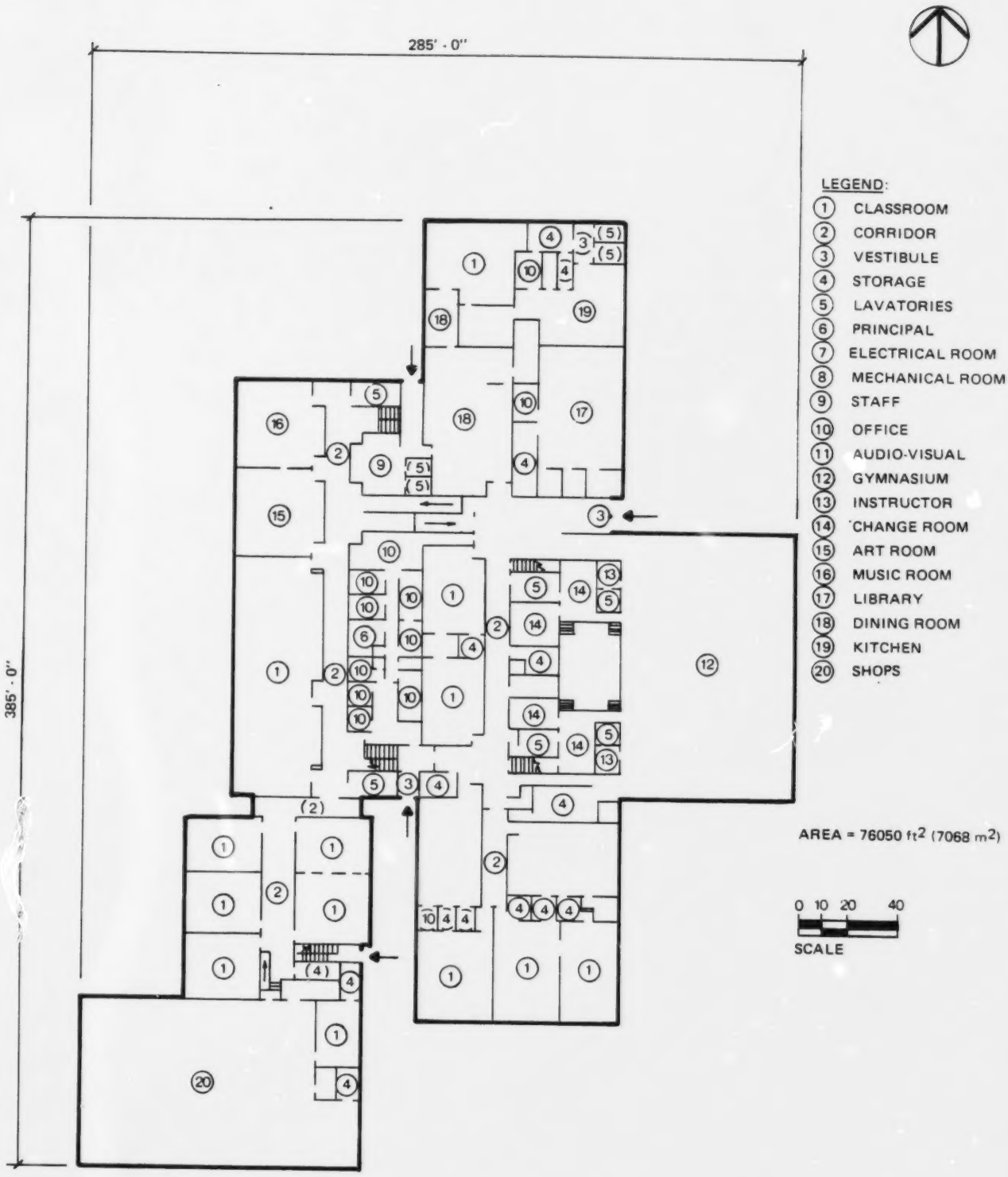
The total annual consumption between January, 1982 and December, 1982 was:

Natural Gas	2,715,651 kWh
Electricity	1,085,760 kWh
Total Annual Consumption	3,801,411 kWh
Energy Index	538 kWh/m^2

Retrofit Measures

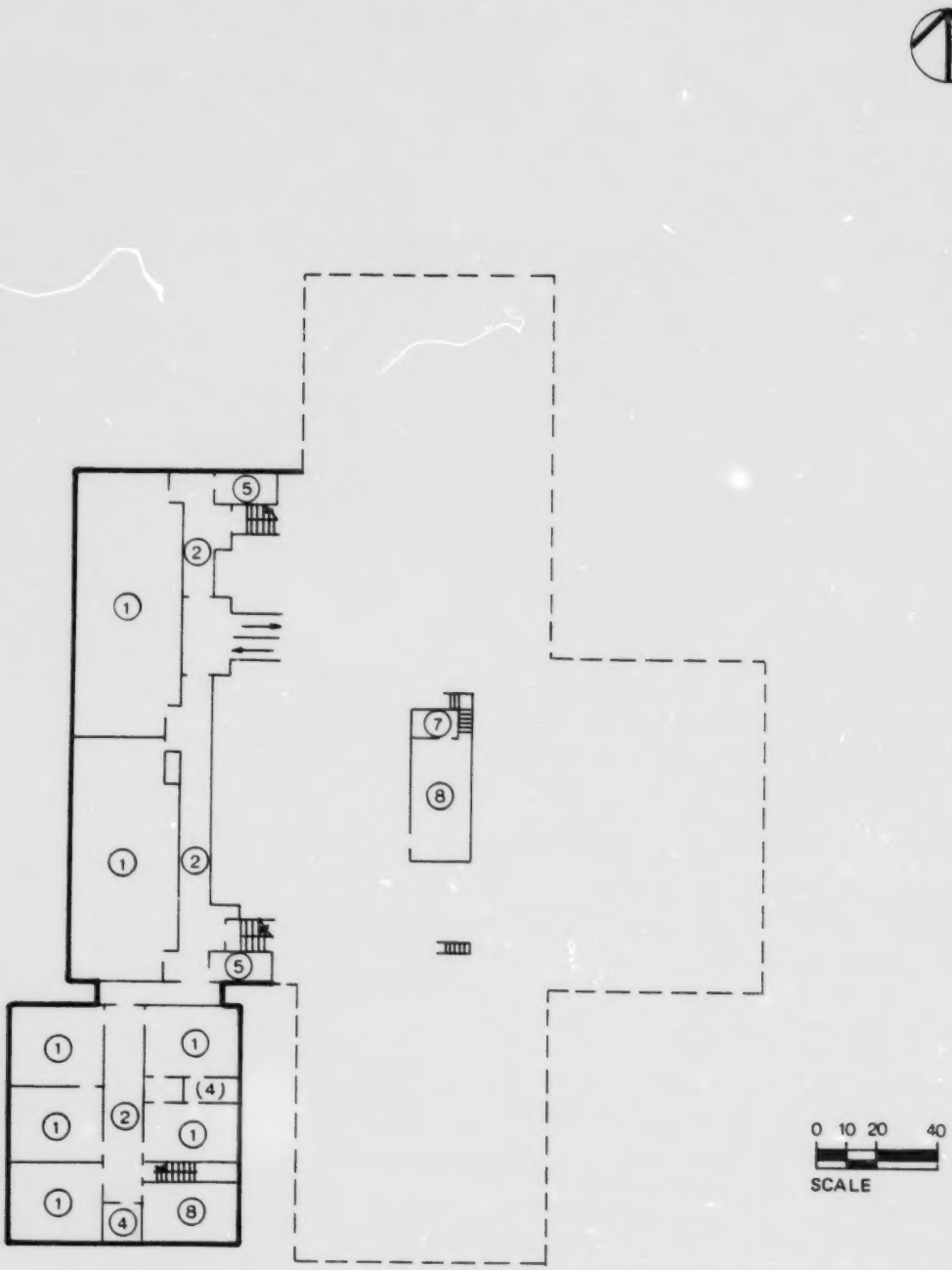
Tables 3, 4 and 5 on the following pages represent all of the retrofit measures investigated at this school. Table 3 shows the recommended retrofit options as they were addressed in the Energy Audit and Analysis Report of November, 1983. The recommended options are within the allocated budget for the school and they all have a payback period of 5 years or less. Table 4 lists additional retrofit options, still within the allocated budget, but with a payback period greater than 5 years. Table 5 lists other options investigated, but which exceed the budget and have higher payback periods.

The items actually implemented are identified on the following tables with an asterisk. These include all of the items on Table 3, as well as Item 2 on Table 4 and Item 2 on Table 5. The total estimated capital implementation cost was $153,385. The annual cost saving was estimated at $20,361, providing an estimated average payback period of 7.5 years.



ENERSCHOOL PROGRAM
PIERRE RADISSON COLLEGIATE, WINNIPEG

FIGURE 2a



ENERSCHOOL PROGRAM
PIERRE RADISSON COLLEGIATE, WINNIPEG

FIGURE 2b

TABLE 3

PIERRE RADISSON SCHOOL

RECOMMENDED RETROFIT OPTIONS

(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Hot Water Temp. Setback	57°C	43°C	Turn temperature down to 43°C	15,880	261	50	0.2
*2.	Thermostat Unoccupied areas	18°C	13°C	Reset Temp. setting and Install lockable covers.	83,450	1,371	700	0.5
*3.	Exhaust Systems Running Time	7 AM to 7 PM	8:30 AM to 3:30 PM Automatic	Install timed circuit with reset time limitation at 8:30 AM to 3:30 PM.	421,940	6,930	2,950	0.5
*4.	Mixed air temp.	13°C	13-18°C	Provide load reset on mixed air controls.	503,072	8,263	9,500	1.1
*5.	Glycol recovery system control	Malfunctioning	Operating	Repair and upgrade control system	152,200	2,500	4,200	1.7
*6.	Ventilation/Heating Morning Start-up	Fresh air damper open	Fresh air damper closed	Install damper override on supply fans.	43,900	721	1,500	2.1
*7.	Thermostats 1968 Building	22°C No covers	20°C Lockable covers	Reset temperature setting and install lockable covers	71,230	1,170	2,500	2.1
*8.	Low leakage dampers	10% leak	1% leak	Install low leakage dampers.	185,234	3,042	7,000	2.3
*9.	Ventilation Running Time	7 AM to 10 PM	Optimum start/ stop and decreased run time	Provide optimum start/ stop control and run time reset.	139,310	2,288	7,000	2.8
*10.	Parking Lot Outlets	7-Day Time Control	Day/night and cycle time outdoor temp. controlled.	Install timed circuit with cycle timer and temperature control set at 7°C. Provide low temperature override.	41 341 (146 kVA/a)	1,653	5,300	3.2
*11.	DHW Tank	Not insulated	Insulated	Insulate DHW storage tank with insulation RSI 1.4	37,290	612	2,000	3.3

TABLE 3 (CONT'D)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*12.	Entrance Doors	Leaking	Repair	Install weather-stripping	33,120	544	2,200	4.0
*13.	Exhaust System	All exhaust	Portion return	Return exhaust air to return air when exhaust is not required	362,070	5,947	25,000	4.2
*14.	Peak Demand Control	No control	Controlled peak demand and duty cycling.	Install controller with duty cycling.	(148 kVA/a)	769	3,500	4.5
*15.	Ventilation temp. control	Fans running	Fans not running	Fans do not run on night cycle when OA is above 4.5°C	3,975	65	300	4.6
*16.	Power Factor	0.9 P.F.	Corrected to .97	Install P.F. correction capacitors and switching control equipment.	(352 kVA/a)	1,830	8,600	4.7
*17.	Recirculating pump DHW control	Manual	Automatic	Shut down pump in night cycle	3,170	52	250	4.8
*18.	Fluorescent Lighting	40 watt lamp	34 watt Econolamps	Replace all fluorescent tubes with Econolamps	50,529 (211 kVA/a)	2,021	10,100	5.0
*19.	Heating and Ventilation	Conventional HVAC control	Microprocessor based energy management control.	Install direct digital control (CPU) system.	Total of Items 3,4,6,9, 14,15,17.	Total of Items 3,4,6,9,14, 15,17.	Included in Items 3,4,6, 9,14,15,17.	As per above
						$40,039	$92,650	2.9

NOTE: Item 19 would replace Items 3, 4, 6, 9, 14, 15, 17.

* ITEMS IMPLEMENTED

TABLE 4

PIERRE RADISSON SCHOOL

POSSIBLE RETROFIT OPTIONS
(within budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Kitchen Exhaust	No heat recovery	Heat recovery	Install heat recovery system on exhaust and makeup air unit.	283,590	4,658	26,000	5.6
*2.	Corridor Ceiling	Normal switching	Photocell controlled	Install photocell control.	1,764	70	735	10
3.	Gymnasium Ceiling	RSI 1.46	RSI 2.11	Spray deck with 25 mm insulation	24,800	407	21,800	54

* ITEMS IMPLEMENTED

TABLE 5

PIERRE RADISSON SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	School Roof	RSI 1.46	RSI 7	Increase roof insulation to RSI=7.	448,290	7,363	265,000	34
*2.	Clerestory Windows	Leaking	Replace	Replace Clerestory windows	16,105	265	60,000	226

* ITEMS IMPLEMENTED

GUYOT SCHOOL

GUYOT SCHOOL - SCHOOL DIVISION NO. 4

Building Description

This school is a single-level structure, built in 1974, with a gross area of 3,437 square metres. In addition to regular classrooms, the school features a Materials Resource Centre, a gymnasium, kindergarten, music rooms, and multi-purpose rooms.

Building construction typically consists of concrete block walls with cast-in-place concrete floor slabs and metal roof deck with steel joists and trusses. Windows are double glazed with aluminum frames and the doors are insulated steel.

Building heating is provided through terminal reheats with hot water being generated in an electric boiler. The vestibule and change rooms utilize perimeter heating. Ventilation is provided to the classroom with two ventilation systems serving the north and south portions of the building respectively. Two separate ventilation units are provided for the gymnasium. A total of five exhaust fans exhaust air from the washrooms, change rooms, etc. Two independent cooling units are provided for classroom area air conditioning only. Domestic hot water is heated electrically.

Classroom lighting consists primarily of recessed fluorescent four-lamp fixtures, with two-lamp fixtures being utilized in the hallway and vestibule areas. Gymnasium lighting is mercury vapour, consisting of open luminaires with 400 W bulbs.

Energy Consumption

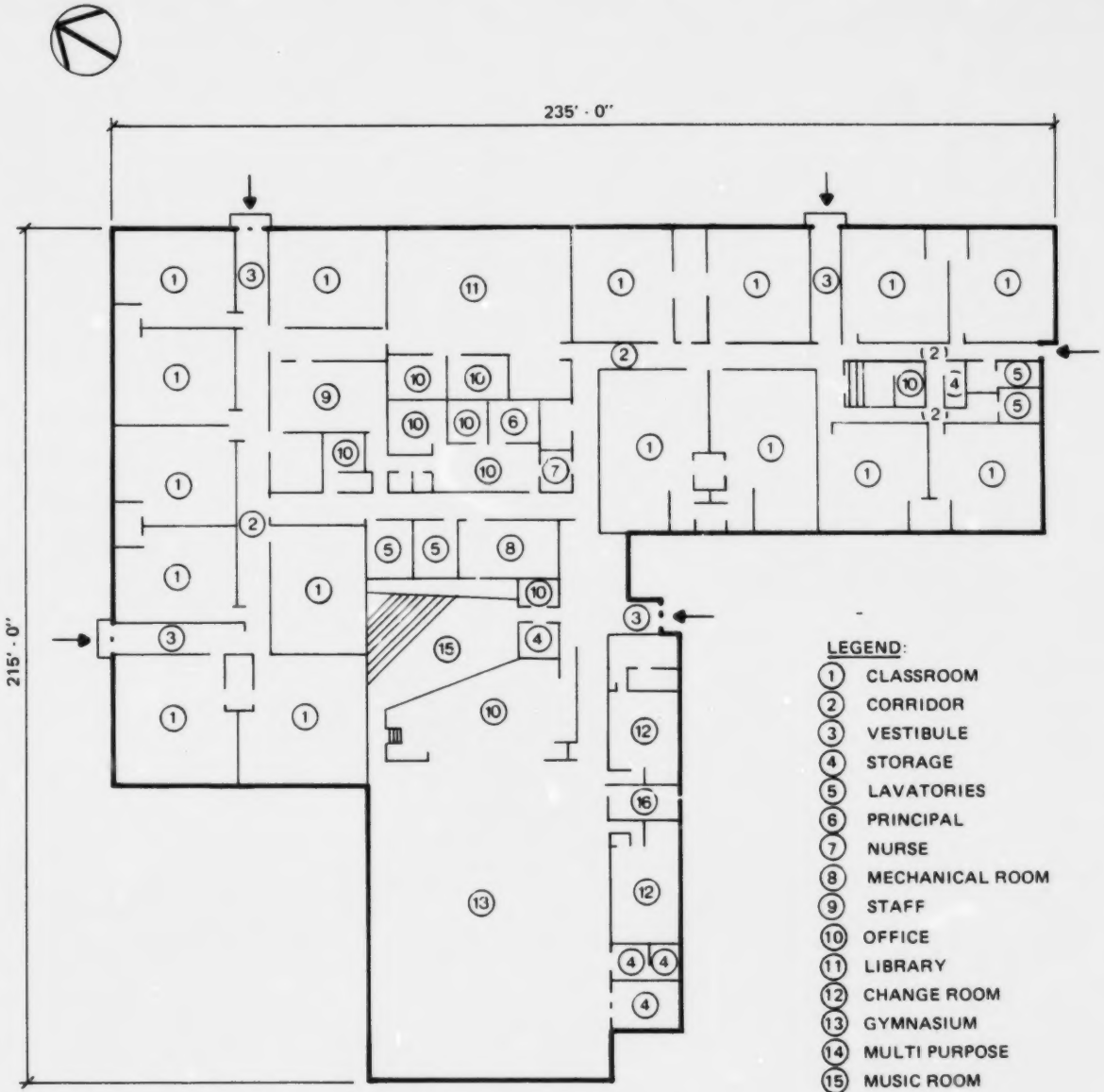
Annual energy consumption for the calendar year 1982 was as follows:

Natural Gas	n/a
Electricity	1,890,000 kWh
Total Annual Consumption	1,890,000 kWh
Energy Index	550 kWh/m^2

Retrofit Measures

Tables 6, 7 and 8 on the following pages represent all the retrofit measures investigated at the school. Table 6 shows the recommended retrofit options as they were addressed in the Enerschool Audit and Analysis Report of November, 1983. The recommended options are within the allocated budget for the school and they all have a payback period of five years or less. Table 7 lists one additional retrofit option with a payback period less than five years, but over budget. Table 8 lists other options investigated but which exceed the budget and have a higher payback period.

An asterisk adjacent to the items on the following tables represent those items actually implemented. The four retrofit measures would provide an estimated cost saving of $3,926/year, with an implemented cost of $123,400. The resulting payback period is 3.2 years.



ENERSCHOOL PROGRAM
GUYOT SCHOOL, WINNIPEG

FIGURE 3

TABLE 6

COYOT SCHOOL

RECOMMENDED RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Hot Water Temp. Setback	54°C	43°C	Turn temperature down to 43°C	6,747	233	0	0
2.	Ventilation Running Time	7 AM to 6 PM	8:30 AM to 3 PM	Reset time 8:30 AM limitation to 3 PM	48,899	1,692	0	0
*3.	Thermostats	22°C	20°C	Reset temperature setting	29,178	1,010	0	0
4.	Exhaust Systems Washrooms	Manual Control	Automatic	Install 7 day timers	55,020	1,904	1,500	0.8
5.	Fans in night cycle	Fans running	Fans not running	Install Control	1,849	64	100	1.6
6.	Parking Lot Outlets	No control	Day/night and cycle time	Install 7 day timer and cycle timer	27,174 (74.5 kVa)	1,326	2,280	1.7
7.	Parking Lot Outlets	No control	Outdoor temp. controlled	Install outdoor thermostat set -7°C	1,162	36	65	1.8
8.	Fresh Air Damper Gymnasium Night Cycle	0.74 m^3/s	0 m^3/s	Modify control on fresh air damper	32,085	1,110	2,000	1.8
*9.	Entrance Doors	Leaking	Repair	Install weatherstripping	21,577	747	1,900	2.5
						$8,122	$7,845	1.0

* ITEMS IMPLEMENTED

TABLE 7

GUYOT SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, less than 5 year payback)

	Item	Conditions		Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
		Existing	Revised					
*10.	Heat Recovery	Exhaust to atmosphere	Preheat fresh air	Install air to air heat exchanger	68,484	2,231	10,500	4.7

* ITEMS IMPLEMENTED

TABLE 8

GUYOT SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Classroom Lighting	1070 Lux	903 Lux	Install Econo Lamp (reduced wattage)	8,118	280	2,552	9.1
2.	Demand Control	Uncontrolled	Regulated peak demand	Install peak demand controller	(270 kVA/a)	1,404	13,500	9.6
3.	School Roof	RSI=3	RSI=7	Increase roof insulation to RSI=7.	101,915	3,526	134,000	38
4.	Gymnasium Ceiling	RSI=3	RSI=3.65	Spray deck with 25 mm Insulation	6,199	214	12,800	60

PRINCE EDWARD SCHOOL

PRINCE EDWARD SCHOOL - SCHOOL DIVISION NO. 9

Building Description

This school is a single-level structure, with a part basement and crawl space. The school was constructed in three stages, with the original school built in 1920 and two additions constructed in 1923 and 1961. The gross floor area of the school as it stands now is 2,310 square metres. The building is generally constructed of masonry brick walls with cast-in-place concrete slab on grade beams. The roof structure is wood decking on wood joists. Windows are double glazed with both wood and aluminum frames. All exterior doors are solid wood.

Because of the numerous additions to this school, there are a variety of mechanical systems in operation. In the original school, including the first addition, heating is by low pressure steam and perimeter radiation. General ventilation is provided by opening windows and there are three local exhaust fans. The second addition, built in 1961, utilized hot air heating with a mixed air system. Additional air change is provided by two local exhaust fans. Domestic hot water is heated with both electric and natural gas water heaters.

Lighting fixtures in both the classrooms and corridors are surface mounted fluorescents. In the gymnasium, 300 W incandescents with open deflectors are utilized.

Energy Consumption

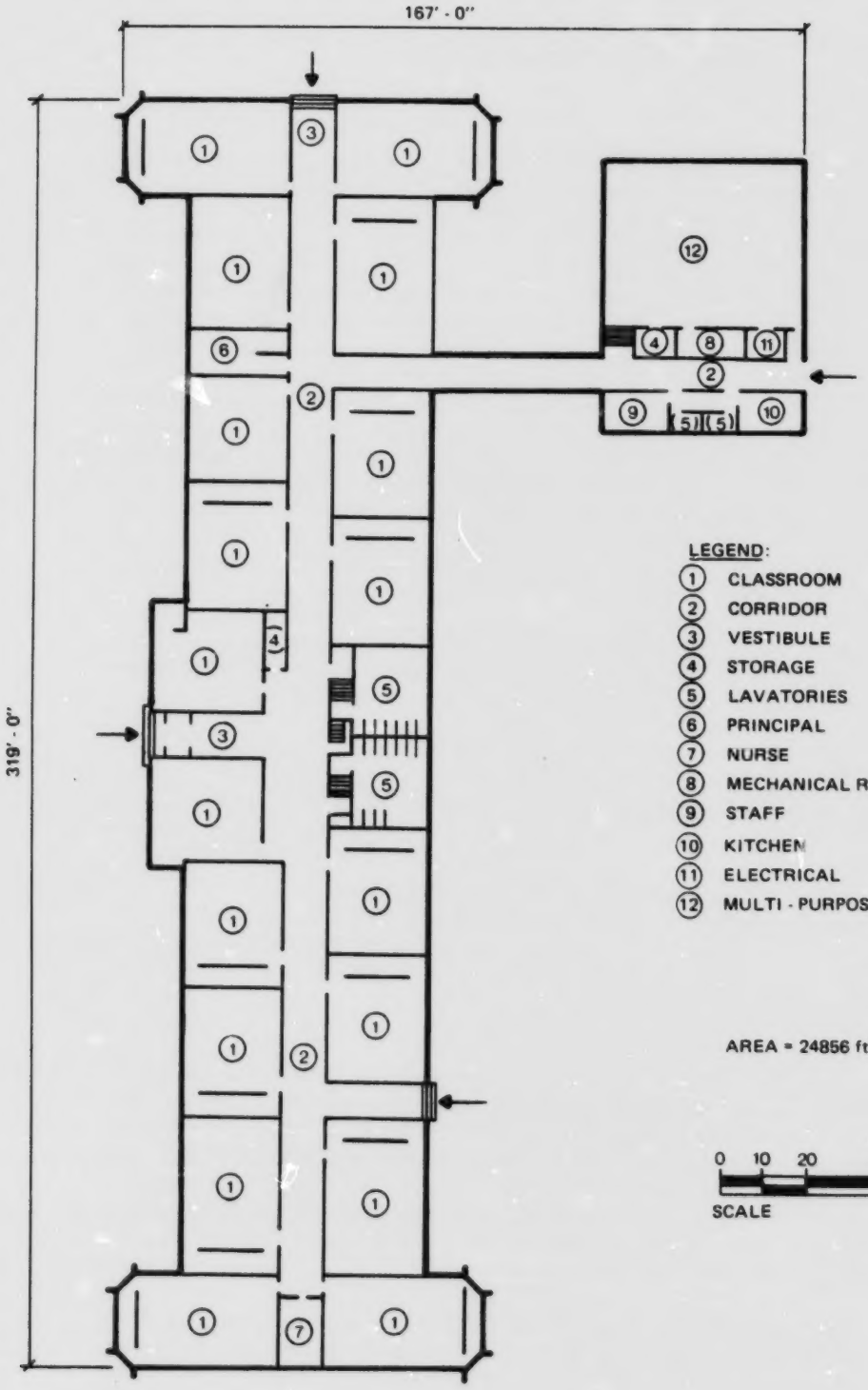
Annual energy consumption for the calendar year 1982 was as follows:

Natural Gas	1,095,633 kWh
Electricity	80,521 kWh
Total Annual Consumption	1,176,154 kWh
Energy Index	509 kWh/m^2

Retrofit Measures

Tables 9 and 10 on the following pages represent all of the retrofit measures investigated for Prince Edward School. Table 9 shows the recommended retrofit options as they are addressed in the Enerschool Audit and Analysis Report of November, 1983. The recommended options are within the allocated budget for the school and they all have a payback period of five years or less. Table 10 lists all other options investigated but which exceeded the budget and which have a payback period greater than five years.

Items actually implemented are listed on Table 9 and are identified by an asterisk. Based upon five steam traps being repaired or replaced (Item 4, Table 9), the total estimated retrofit cost is $6,570. The reduction in energy consumption is estimated at 105,538 kWh, resulting in a cost saving of $2,671. The calculated payback period is 2.5 years.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. KITCHEN
11. ELECTRICAL
12. MULTI - PURPOSE

AREA = 24856 ft^2 (2310 m^2)

0 10 20 40
SCALE

ENERSCHOOL PROGRAM
PRINCE EDWARD SCHOOL, WINNIPEG

FIGURE 4

TABLE 9

PRINCE EDWARD SCHOOL

RECOMMENDED RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Hot Water	60°C & 68°C	43°C	Turn temperature down to 43°C	725	434	20	0.1
2.	Thermostat - Unoccupied area	23°C	13°C	Reset temp. setting	26,270	431	50	0.1
3.	Thermostats (Bldg. 1920-1923)	23°C	18°C	Reset temp. setting	45,600	749	100	0.1
*4.	20 mm Steam Trap	May be leaking	Repair	Repair trap or replace	14,200	233 ea.	40 ea.	0.4
5.	Thermostats (Bldg. 1961)	20°C	18°C	Reset temp. setting	2,153	35	20	0.6
6.	Heating System Control	Manual Control	Automatic	Install 7-day timer	26,800	440	400	0.9
*7.	Parking Lot Plugs	No control	Day/night and cycle time	Install 7 day timer and cycle timer	16,185	777	1,150	1.5
*8.	Exhaust System Washrooms	Manual Control	Automatic	Install 7 day timer	12,750	209	350	1.7
*9.	Corridor Temp. Control	Manual	Automatic	Install thermostats and control valves	41,900	688	2,500	3.6
*10.	Entrance Doors	Leaking	Repair	Install weatherstripping	16,500	271	1,000	3.7
*11.	Night Setback	1 night thermostat	Two setting thermostats	Install PKV for pneumatic system	17,800	293	1,350	4.6
12.	Thermostat	Not working	Repair	Repair thermostat or replace	600	10	50	5.0
	* ITEMS IMPLEMENTED					4,570	7,030	1.5

Note: Item No. 4 is per trap. The total cost savings and capital cost expressed in the text is based on 5 traps being repaired or replaced.

TABLE 10

PRINCE EDWARD SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	School Roof (Bldgs. 1920-1923)	RSI 0.5	RSI 7	Increase roof insulation by 100 mm	537,000	8,825	80,000	9.1
2.	School Roof (Bldg. 1920-1933)	RSI 0.5	RSI 7	Increase roof insulation by 200 mm	582,444	9,570	123,800	12.9
3.	Gymnasium Ceiling	RSI 0.90	RSI 1.5	Spray deck 25 mm Insulation	13,660	224	5,500	25

* ITEMS IMPLEMENTED

SPRINGFIELD JUNIOR HIGH SCHOOL

SPRINGFIELD JUNIOR HIGH SCHOOL - SCHOOL DIVISION No. 12

Building Description

Springfield Junior High School was built between the years 1968 and 1969. The school is a two-level structure with crawl space, having a gross floor area of 4,439 square metres. In addition to the classroom, office and washroom areas, the school has special use areas such as multi-purpose rooms, drafting areas, music rooms, metal and woodworking shops, clothing and food workshops, as well as a gymnasium.

The major components of building construction are concrete block walls with brick facing, structural concrete slabs on the main and second floors, and built-up roofing on steel roof deck and steel joists. Windows are double glazed with aluminum frames and entry doors are insulated steel.

Heating is provided through thirteen air handling units with electric heating coils. Local electric heaters are utilized in stairwells and vestibules. Air conditioning is provided to the classrooms through six built-in cooling coils from the main floor air handling systems, as well as seven independent units for the second floor classrooms. Domestic hot water is heated electrically.

Classroom lighting consists of recessed fluorescent fixtures, whereas vestibule and stairwell lighting is incandescent. Gymnasium lighting is a combination of mercury vapour and 500 W incandescent fixtures.

Energy Consumption

Annual energy consumption between April 1982 and March 1983 was as follows:

Natural Gas	n/a
Electricity	1,176,000 kWh
Total Annual Consumption	1,176,000 kWh
Energy Index	265 kWh/m^2

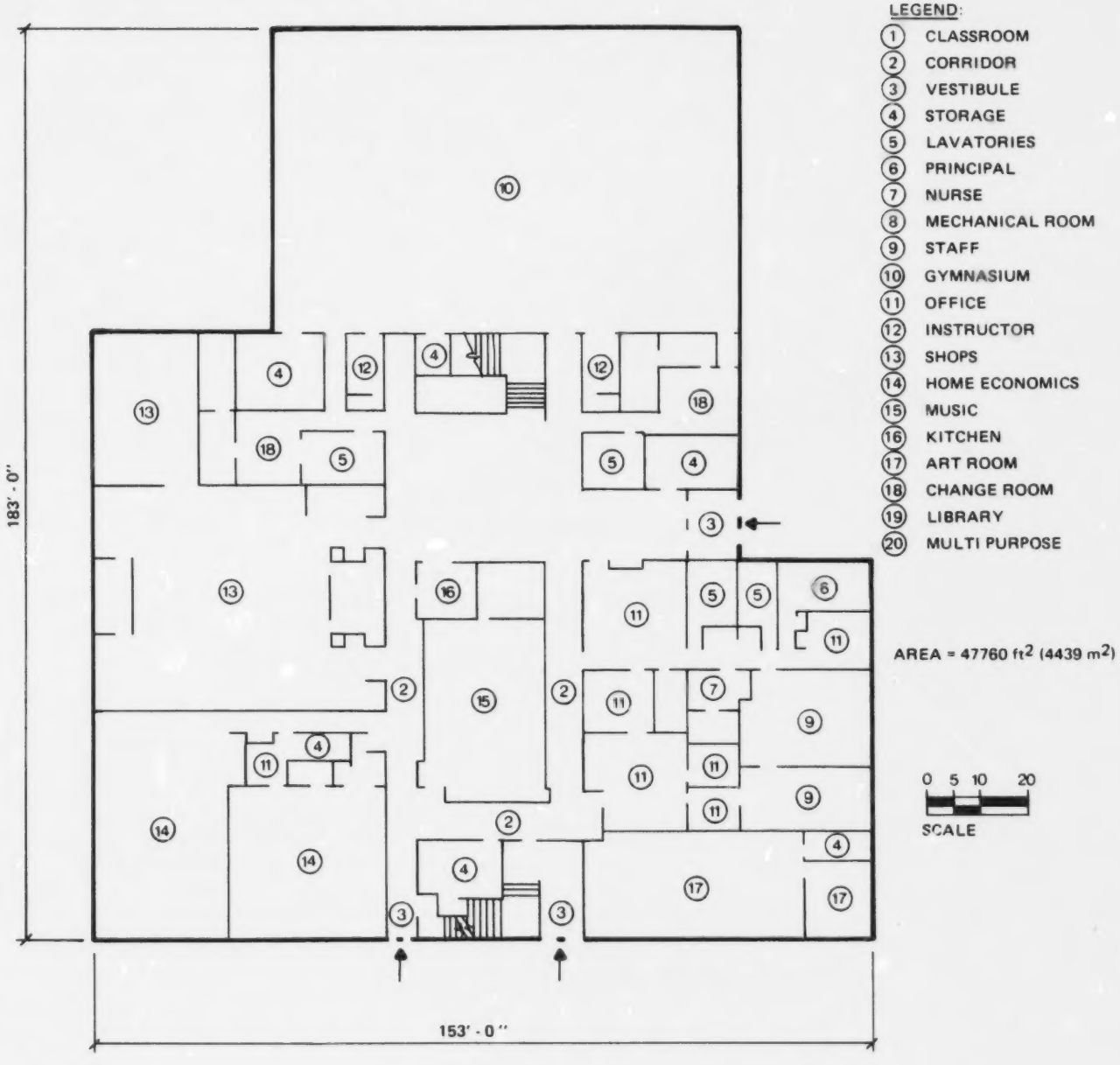
Retrofit Measures

Tables 11, 12 and 13 on the following pages represent all of the retrofit measures investigated at this school. Tables 11 and 12 represent the recommended retrofit options as they were addressed in the Enerschool Audit Analysis Report of November, 1983. The recommended options of Table 11 are within the allocated budget for the school and all items addressed have a payback period of five years or less. Table 12 lists one additional retrofit option which exceeds the allocated budget but which has a payback period of less than five years. Table 13 lists three additional options which were investigated, but which have excessive payback periods and exceed the budget.

Item No. 9 on Table 12 was the one selected option. Sequence control of the heating and ventilating system included optimum start and stops, night cycle setbacks, duty cycling and demand control of the electric hot water heaters, parking lot plugs, and air handling units. This one option supercedes some of the recommended retrofit options shown on Table 11, such as:

2. Ventilating running time
5. Parking lot outlets
7. System demand controlling

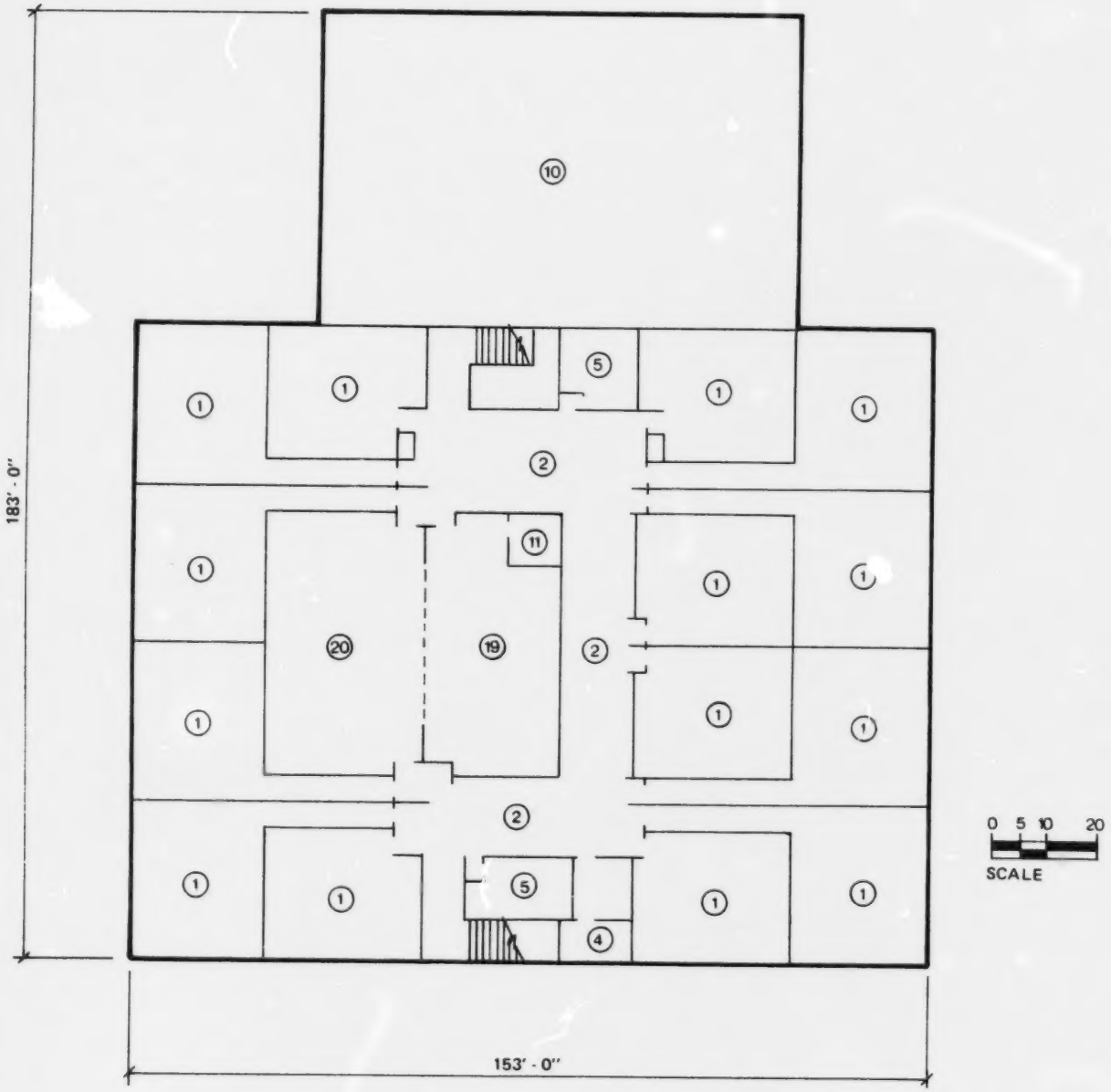
A direct digital control system such as this was estimated to save 40,000 kWh/year, as well as demand charges of 533 kVA. A cost saving of $3,970/year applied to the implementation cost of $19,000 provided an estimated average payback period of 4.8 years.



MAIN FLOOR PLAN

ENERSCHOOL PROGRAM
SPRINGFIELD SCHOOL, OAKBANK

FIGURE 5a



2ND FLOOR PLAN

ENERSCHOOL PROGRAM
SPRINGFIELD SCHOOL, OAKBANK

FIGURE 5b

TABLE 11

SPRINGFIELD JUNIOR HIGH SCHOOL

POSSIBLE RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Hot water temp. setback	52°C	43°C	Turn temperature down to 43°C	4 072	122	0	0
2.	Ventilation running time	6 AM to 6 PM	8 AM to 3 PM	Reset time 8 AM to 3 PM	20 799	624	0	0
3.	Exhaust reduction	2.6 m^3/s	1.38 m^3/s	Reduce fan rpm (Fans 1-5)	64 369	1,931	750	0.4
4.	Mixed air temp.	13°C	18°C	Reset mixed air temp. Units No. 1 to 13 Relocate temp. sensors	148 382	4,451	2,500	0.5
5.	Parking Lot Outlets	No control	Day/night cycle time and temp. control	Install clock, time and thermostat	30 068 (74.5 kVA/a)	1,289	2,890	2.3
6.	Entrance door	Leaking	Repair	Install weatherstripping	11 524	346	1,000	2.9
7.	System demand controller	No control	Peak demand controlled	Install controller and associated interphase	(533 kVA/a)	2,770	8,900	3.2
8.	Windows	Leaking	Repair	Install weatherstripping	2 131	64	300	4.7
						11,597	16,340	1.4

* ITEMS IMPLEMENTED

TABLE 12

SPRINGFIELD JUNIOR HIGH SCHOOL

RECOMMENDED RETROFIT OPTIONS
(over budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*9.	Heat and vent sequence control	Manual	Automatic	Install microprocessor direct digital control system	40,000 (533 kVA/a)	3,970	19,000	4.8

NOTE: Implementation of Item 9 would eliminate the need for Item 7, System Demand Controller.

*ITEMS IMPLEMENTED

TABLE 13

SPRINGFIELD JUNIOR HIGH SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	School Roof	RSI=3.6	RSI=5.00	Increase roof insulation by 50 mm	60 735	1,822	110,900	60
2.	Ventilation temperature control	Fans running	Fans not running	Fan does not run on night cycle when OA is above 4.5°C	1 299	39	2,800	72
3.	Gymnasium Ceiling	RSI=3.6	RSI=4.39	Spray deck 25 mm Insulation	3 977	119	14,300	120

TRANSCONA COLLEGIATE

TRANSCONA COLLEGIATE - SCHOOL DIVISION NO. 12

Building Description

Transcona Collegiate is a multi-level structure, with a part basement and crawl space occupying a gross floor area of 5,634 square metres. The school was built in two stages; the original school was constructed in 1960 with a six-classroom addition the following year. Major areas of the school are classrooms, gymnasium, change rooms, showers, washrooms, library, laboratories and mechanical/electrical storage rooms.

Walls are generally of concrete block construction. The floors are concrete slab on steel joists. Built-up roofing on steel deck and joists is common for the school roof, whereas the curved gymnasium roof utilizes built-up roofing on wood decking and curved wooden beams. Windows are double glazed with wood frames and exterior doors are glass and aluminum.

School heating is provided by a gas-fired hot water boiler with water being circulated to individual unit ventilators in each classroom and hot water radiators in the offices, washrooms, gymnasium and hallways. A central air conditioning system is provided for the office and administration building only. Ventilation, other than classrooms, is provided with local exhaust fans in the office, laboratory and washroom areas. Ventilation in the gymnasium is provided by one return and one supply fan. Domestic hot water is provided by three gas-fired water heaters.

Classroom lighting consists of pendant-mounted fluorescent fixtures, whereas hallway lighting utilize surface-mounted fluorescent fixtures. The gymnasium is illuminated with 500 W incandescent open reflector luminaires.

Energy Consumption

Annual energy consumption between May, 1982 and April, 1983, was:

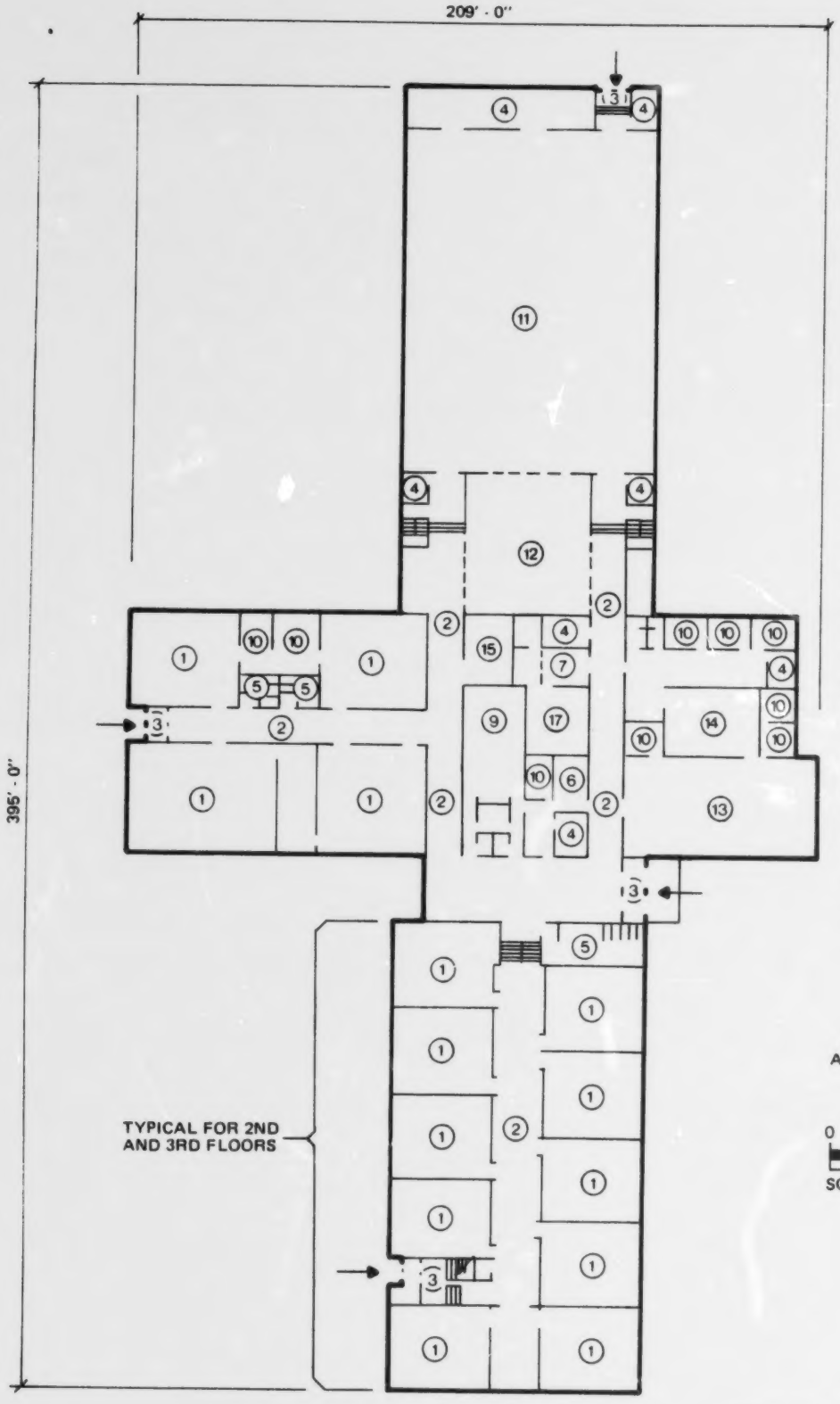
Natural Gas	1,914,130 kWh
Electricity	371,320 kWh
Total Annual Consumption	2,285,450 kWh

Energy Index 406 kWh/m^2

Retrofit Measures

Tables 14, 15 and 16 on the following pages represent all the retrofit measures investigated at this school. Table 14 shows the recommended retrofit options as they were addressed in the Enerschool Audit and Analysis Report of November, 1983. The recommended options are within the allocated budget for the school and they have a payback period of five years or less. Table 15 lists additional retrofit options still within the allocated budget, but with payback periods greater than five years. Table 16 lists one additional option which could be implemented but which exceeds both the five year payback period and the budget.

Four items on Table 14 and all of the items on Table 15 were implemented. An asterisk identifies these items on the tables. For an estimated capital expenditure of $21,940, it is expected that 301,630 kWh can be saved annually. This equates to approximately $7,330 in annual cost savings, resulting in an estimated payback period of 3.0 years.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. OFFICE
11. GYMNASIUM
12. MULTI PURPOSE
13. LIBRARY
14. BOARD ROOM
15. KITCHEN
16. CHANGE ROOM (IN BASEMENT)
17. COURT YARD

AREA = 60615 ft^2 (5634 m^2)

0 10 20 40
SCALE

ENERSCHOOL PROGRAM
TRANSCONA COLLEGIATE, WINNIPEG

FIGURE 6

TABLE 14

TRANSCONA COLLEGIATE

RECOMMENDED RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Domestic hot water	65°C	50°C	Manual reset	4,316	71	0	0
*2.	Washroom exhaust fan	Continuous running	8 a.m. - 5 p.m. weekdays	Install 7-day timer	79,000	1,300	750	0.6
3.	Parking lot outlets	No contrl	Install Control system	7-day timer, cycle timer and temperature control	36,618 (101 kVA/a)	1,710	2,950	1.7
*4.	Night setback temperature controller	Malfunctioning	Replace	Install controller, repair setback.	266,750	4,381	7,600	1.8
*5.	Service entrance metering	2 metered service	1 metered service	Install new metering cabinet at transformer		1,615	3,150	1.9
*6.	Entrance door	Leaking	Repair	Install new weatherstripping	12,770	209	500	2.4
						9,286	14,950	1.6

*ITEMS IMPLEMENTED

TABLE 15

TRANSCONA COLLEGIATE

POSSIBLE RETROFIT OPTIONS
(within budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Windows	Plywood blocking	Insulate with fiberglass	Add fiberglass and plywood for protection	21,980	361	2,400	6.6
*2.	Gymnasium lighting	500W incandescent	Color corrected high pressure sodium.	Replace existing fixtures, reduce number of fixtures to 18.	11,617	890	5,990	6.7
*3.	Outdoor lighting	Incandescent	Mercury vapor	Replace outdoor flood lighting around gymnasium	2,160	82	1,550	19

* ITEMS IMPLEMENTED

TABLE 16

TRANSCONA COLLEGIATE

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Gymnasium roof	RSI 0.79	RSI 2.19	Spray with 50 mm polystyrene foam	103,400	1,697	26,000	15.3

WESTVIEW SCHOOL

WESTVIEW SCHOOL - SCHOOL DIVISION NO. 12

Building Description

Westview School was built in three stages; an original structure in 1953, one addition in 1957 and a second addition in 1969. The school is a single level structure, with a part basement and crawl space, occupying a gross floor area of 2,432 square metres.

The school's major areas are classrooms, library, kindergarten, music room, and gymnasium.

The original school and the first addition utilize wood walls on a structural concrete slab, wood joists and wood decking with built-up roofing. The second addition in 1969 was constructed with concrete block walls with brick facing, structural concrete slab on grade beam and built-up roofing on a metal roof deck with steel joists and trusses. Windows and doors of all sections of the school are double glazed with aluminum frames and insulated aluminum or steel doors.

Heating of the original school and the first addition is provided by low pressure steam and perimeter radiation. Classroom ventilation is provided with a solitary supply air system with fresh air intake. In addition, there are two local exhaust fans. Classrooms in the second addition are heated and ventilated with a hot air supply system. This addition is also supplemented with two local exhaust fans. The gymnasium is also ventilated and heated with a hot air supply system. Domestic hot water is generated and stored in an electric hot water heater.

Each classroom in the older areas is provided with surface mounted fluorescent fixtures. Fixtures in the second addition are two lamp, 40 W recessed fluorescents. Corridor fixtures in the original building and the first addition are surface mounted with wrap-around diffusers. Gymnasium lighting is a combination of 400 W mercury vapour with 500 W incandescent lighting.

Energy Consumption

Annual energy consumption from April, 1982 to March, 1983 inclusive was:

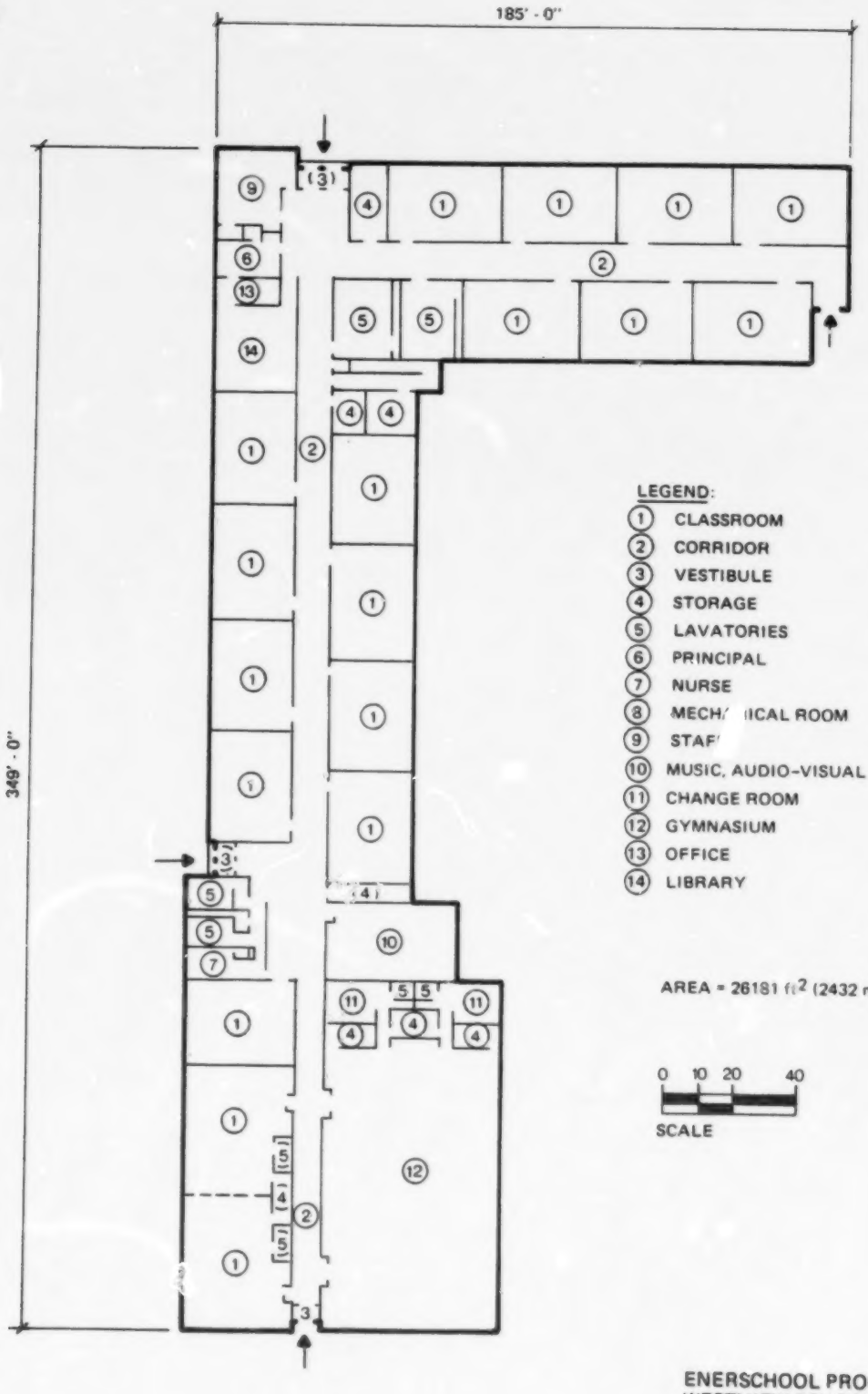
Natural Gas	1,231,829 kWh
Electricity	187,440 kWh
Total Annual Consumption	1,419,269 kWh
Energy Index	484 kWh/m^2

Retrofit Measures

Tables 17 and 18 on the following pages, represent all the retrofit measures investigated at this school. Table 17 highlights the recommended retrofit options as they were addressed in the Enerschool Audit and Analysis Report, November, 1983. The recommended options are within the allocated budget for the school and all have a payback period of five years or less. Table 18 lists other possible retrofit options investigated. The five options tabulated here exceeded the allocated budget and had payback periods of greater than five years.

Virtually all of the options recommended were implemented. In addition, three of the five additional retrofit options tabulated in Table 18 were implemented. However, one of these items was slightly modified during the implementation stage. This was Item 1 on Table 18, vestibule lighting. The investigated retrofit involved the removal of fluorescent tubes from the fixture and the replacement of the ballast, whereas the implemented measure involved the replacement of 40 W tubes with new "Econowatt" 34 W tubes. The implemented items are marked with an asterisk on Tables 17 and 18.

The implementation of these items is expected to save 466,279 kWh/yr. The resultant cost reduction of $7,645 when compared to the estimated capital cost of $14,500 provides an estimated average payback period of 1.9 years.



ENERSCHOOL PROGRAM
WESTVIEW SCHOOL, WINNIPEG

FIGURE 7

TABLE 17

WESTVIEW SCHOOL

RECOMMENDED RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Hot Water Temp. Setback	60°C	43°C	Turn temperature down to 43°C	9,054	344	0	0
*2.	Fresh Air Damper (1953 and 1957 buildings)	1.865 m^3/s	1.13 m^3/s	Readjust position on fresh air damper	50,490	829	0	0
3.	Ventilation Control (1969 Bldg)	6 AM to 10 PM	7 AM to 9 PM	Reset time limitation 7 AM to 9 PM	11,520	189	0	0
*4.	12 mm Steam Traps	May be leaking	Repair	Repair trap or replace	35,640	585 ea.	180 ea.	0.3
*5.	20 mm Steam Traps	May be leaking	Repair	Repair trap or replace	42,550	700 ea.	270 ea.	0.4
*6.	Reduce Air Exhaust (1955-1957)	1.51 m^3/s	0.638 m^3/s	Reduce rpm of the fans	80,650	1,325	500	0.4
*7.	Exhaust System (1953 & 57 Bldg)	Manual Control	Automatic	Install 7 day timer	39,700	652	625	1.0*
*8.	Parking Lot Plugs	No control	Day/night and cycle time	Install 7 day timer and cycle timer	29,857	1,134	1,750	1.5
*9.	Exhaust System (1969 Bldg)	Manual Control	Automatic	Install 7 day timer	21,350	351	625	1.9*
*10.	Heating Control (1955 & 57)	One setting manual	Two settings time controlled	Replace all room stats in original building first addition.	118,800	1,951	5,500	2.8
*11.	Entrance Doors	Leaking	Repair	Install weatherstripping	17,950	295	1,200	4.1
						8,355	10,650	1.3

*ITEMS IMPLEMENTED

Note: Item No. 4 and 5 are per trap. The total cost savings and capital cost expressed in the text are based on 5 12 mm and 3 20 mm traps being repaired or replaced.

TABLE 18

WESTVIEW SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Vestibule Lighting	520 Lux	320 Lux	Remove tubes Replace ballast	1,010	38	240	6.3
*2.	Ventilation Control	Normal time clock control	Outside temperature control	Install Paragon EC403 energy optimizer.	100,400	165	1,500	9
*3.	Temperature Kindergarten	6 AM to 10 PM 20°C	7 AM to 4 PM - 20°C 4 PM to 7 AM - 13°C	Install timed early set back.	5,400	89	850	9.5
4.	Gymnasium Ceiling	RSI=0.78	RSI=1.57	Spray deck 25 mm Insulation	25,040	411	9,100	22
5.	School Roof	RSI=0.79	RSI=1.62	Increase roof insulation by 50 mm.	137,450	2,258	87,500	39

* ITEMS IMPLEMENTED

H. C. AVERY SCHOOL

H. C. AVERY SCHOOL - SCHOOL DIVISION NO. 10

Building Description

The original section of this school was built in 1956 with a single storey addition constructed in 1971. Both sections of the school are single level with a part basement and crawl space. The school's gross floor area is 2,535 square metres. The school features a gymnasium and a music room, in addition to classrooms, offices, washrooms, change rooms, and mechanical/electrical rooms.

The walls in the school are primarily concrete block with wood floors and wood floor joists and built-up roofing on wood decking and wood joists in the original school section. The 1971 addition has concrete slab flooring with built-up roofing on steel deck and steel joists. Windows in both sections generally consist of double glazed units with wood or aluminum frames and door systems are all insulated aluminum.

Heating in the old section of the school is hot water generated by two gas-fired boilers. The water is circulated through heating coils in the hot air distribution system to each classroom. The rooftop air handling unit provides ventilation as well as cooling. In the 1971 addition, heating, ventilation and cooling is provided by a packaged rooftop air handling unit with individual electric heating coils and air ducts to each zone. Ventilation in both sections of the school are supplemented by three local exhaust fans. The gymnasium is provided with a separate rooftop air handling unit with electric heating and cooling. Hot water for domestic purposes is provided by two electric hot water heaters, one located in each section of the school.

The original school section is provided with pendant-mounted fluorescent fixtures in each classroom. Corridor fixtures in this section of the building are surface-mounted fluorescent without diffusers. The 1971 addition illuminates the classrooms with four-lamp recessed fluorescent fixtures. The gymnasium is provided with 500 W incandescent open reflectors with lamps.

Energy Consumption

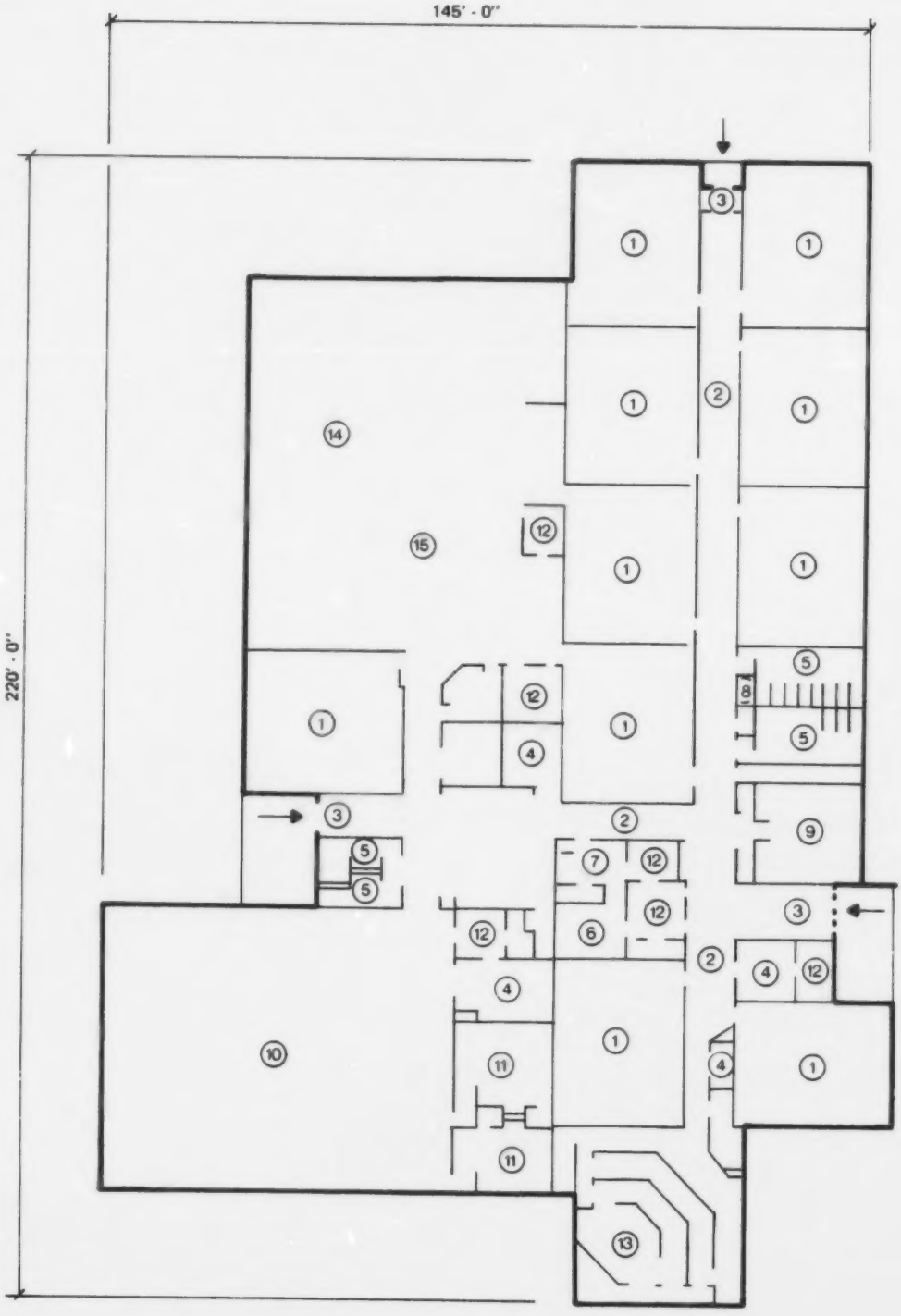
Annual energy consumption for the calendar year 1982 was:

Natural Gas	351,000 kWh
Electricity	638,600 kWh
Total Annual Consumption	989,600 kWh
Energy Index	390 kWh/m^2

Retrofit Measures

Tables 19, 20 and 21 on the following pages represent all the retrofit measures investigated at this school. Table 19 reflects the recommended retrofit options as they were addressed in the Enerschool Audit and Analysis Report, November, 1983. The recommended options are within the allocated budget for the school and they all have a payback period of five years or less. Table 20 lists additional retrofit options still within the five year payback period, but over budget. Table 21 lists other options but which exceed the budget and have payback periods greater than five years.

Table 19 indicates all of the items implemented. These are identified with a preceding asterisk before each item. The total implementation cost is $7,795. Annual energy savings are estimated at 243,000 kWh, resulting in a cost saving of $7,905/yr. The estimated average payback period is 1.0 year.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. GYMNASIUM
11. CHANGE ROOM
12. OFFICE
13. MUSIC ROOM
14. OPEN AREA
15. LIBRARY

AREA = 27270 ft^2 (2535 m^2)

0 5 10 20
SCALE

ENERSCHOOL PROGRAM
H.C. AVERY SCHOOL, WINNIPEG

FIGURE 8

TABLE 19

H.C. AVERY SCHOOL

RECOMMENDED RETROFIT OPTIONS
(within budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
*1.	Reset mixed air temperature							
	Classroom Addition	13°C	18°C		40 800	1,714	0	0
	Gymnasium	13°C	18°C		25 800	1,083	0	0
	Original School	4.4°C	18°C		163 530	2,686	0	0
*2.	Reduce washroom exhaust	2.1 m^3/s	1.35 m^3/s	Reduce fan rpm	37 200	1,562	800	0.5
*3.	Domestic hot water circulation pumps	Continuous Duty	Day/night time control	Install control timer	4 512	189	180	1.0
*4.	Entrance Door	Leaking	Repair	Readjust and realign doors	22 554	370	380	1.0
*5.	Reduce library illumination level	1290 Lux	806 Lux	Remove lamps and ballasts	2 825	118	170	1.4
*6.	Auto control on parking plugs	Manual	Auto	Install 7-day timer and control system	23 598 (120 kVA/a)	1,650	2,280	1.4
*7.	Washroom fan timer control	Manual	Auto timer	Install 7-day cycle timer	15 000	630	880	1.4
*8.	Service entrance metering	2 metered service	1 metered service	Remove 600A service entry	0	850	1,370	1.6
*9.	Insulate domestic hot water pipes	Not Insulated	Insulated	Insulate with 38 mm glass wool	9 700	407	1,600	3.9
*10.	Roof Access Hatch	Not Insulated	Insulated & weatherstripped	Insulate with 50 mm styrofoam and weatherstripping	820	34	135	4.0
						11,293	7,795	

* ITEMS IMPLEMENTED

TABLE 20

H.C. AVERY SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, less than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Central night setback	Manual setting	13°C setback	Install thermostats & control system				
	1971 Addition				59 000	2,473	5,570	2.2*
	Original School				10 000	1,700	2,700	1.6

*Cost Includes duty cycling with limited peak demand control.

TABLE 21

H.C. AVERY SCHOOL

POSSIBLE RETROFIT OPTIONS
(over budget, greater than 5 year payback)

	Item	Conditions: Existing	Conditions: Revised	Description	Energy Saved (kWh/a)	Cost Saving ($/a)	Implementation Cost ($)	Average Payback Period (Years)
1.	Classroom Lighting 1971 Addition	968 Lux	870 Lux	Install reduced wattage lamps	4 415	185	1,150	7.0*
2.	Classroom Lighting Original School	1070 Lux	903 Lux	Install reduced wattage lamps	2 138	90	805	9.0*
3.	Old School Roof	RSI-0.15	RSI=2.5	Spary deck 50 mm Insulation	66 705	1100	25,500	23
4.	Gymnasium Ceiling	RSI-1.47	RSI=2.90	Spray deck 50 mm Insulation	9 223	255	8,500	33

*Install energy efficient tubes on a burn out basis.

RURAL SCHOOLS

ERICKSON COLLEGIATE

ERICKSON COLLEGIATE, ERICKSON

Building Description

Compared to the other rural schools in the program, Erickson Collegiate can be considered as intermediate in total area. The school was constructed in two phases. The initial construction occurred in 1963 while the second phase occurred in 1972.

The school consists of a gymnasium with showers and change facilities, a multi-purpose area, two science labs, a resource centre, a student lounge, administration area (5 offices), staff lounge, 12 classrooms and miscellaneous room areas (storage, washrooms, mechanical rooms and corridors).

The total school area is 2,494 square metres with an exterior perimeter of 251 metres.

The building is a single level structure with crawl space under the original building only. The newer building is constructed with a concrete slab on grade.

The wall construction is as follows:

New School: 101.6 mm (4") face brick, air space, 38.1 mm (1 1/2") of rigid insulation, vapour barrier and concrete block (RSI 1.3/R7.5).

Domestic hot water is provided by one 272.8 litre (60 gallon) hot water tank with 2 - 4500 W elements. There is no recirculation system. The electric service is rated at 115/230V, single phase, 3 wire, 285 A. The service is split and power is monitored through two meters. Power costs are charged at the General Service Rate.

The classrooms and hallways are lit with fluorescent fixtures.

Energy Consumption

Annual energy consumption was as follows:

Oil	769,992 kWh
Electricity	380,971 kWh
Total Annual Consumption	1,150,963 kWh
Energy Index	461 kWh/m^2/a

Retrofit Measures

The total capital budget identified for Erickson Collegiate is $8,855.00 compared to an estimated total value for recommended retrofit items of $8,080.00. The retrofit options selected by the school priced within the capital budget are items 1, 2, 3, 4, 5, 6, 7 and 8 with a payback of five years or less, and items 1 and 2 with a payback greater than five years. A brief description of the selected retrofit items, shown in Tables 22 and 23, is as follows:

1. Hot Water Tank - It was recommended that the setting of the tank be reset from 57.2°C (135°F) to 43.3°C (110°F) as an energy conservation measure. The quality of hot water should be unaffected by the reduction in the temperature setting of the tank. The cost savings identified by this retrofit assume that the domestic hot water lines in the crawl space are insulated. If they are not insulated, the saving resulting from resetting the hot water temperature will be about two and one-half times the value indicated.

2. Gym Ventilation Unit - The fan was controlled by a central computer to run between 8:30 a.m. and 3:30 p.m. There is no regulation of the fresh air supply other than the mixed air controller. It was recommended that during unoccupied periods during the normal run hours the fresh air damper be fully closed and the unit operated on full return air to achieve a saving on heating costs. This control was to be accomplished with a wall mounted manual reset timer (0-60 minutes) and an electric/pneumatic relay to disable the mixed air control. The savings identified assume that fresh air can be closed off for three hours per day and only when the outside air temperature is less than 5°C (41°F).

3. Exhaust Fans F1, F2, F4, F12 and F15 - These fans were manually controlled. A heating cost savings results by reducing the amount of exhausted air. It was recommended that this reduction be affected with the use of time clocks operating on a prescribed schedule.

4. Corridor Ventilation Unit - The unit ran 24 hours per day. It was recommended that a heating cost saving be implemented by connecting the unit to the central computer for operation during normal occupancy hours only.

5. MPR Room Lighting - The light level in this room was observed to be excessively high. It was recommended that a total of 12 fixtures (3 fixtures per row) be disconnected to allow for an adequate light level with a reduction in electrical utility costs as indicated in the table.

6. Gym Relief Fans - These fans were controlled manually and were possibly run when not necessary. It was also noted that the back-draft dampers on the inlet to the fans continually relieved room air. It was recommended that these fans be removed and all but one roof opening be sealed. A single relief hood with a motorized damper was to be installed with control for this unit from the gym vent unit mixed air controller.

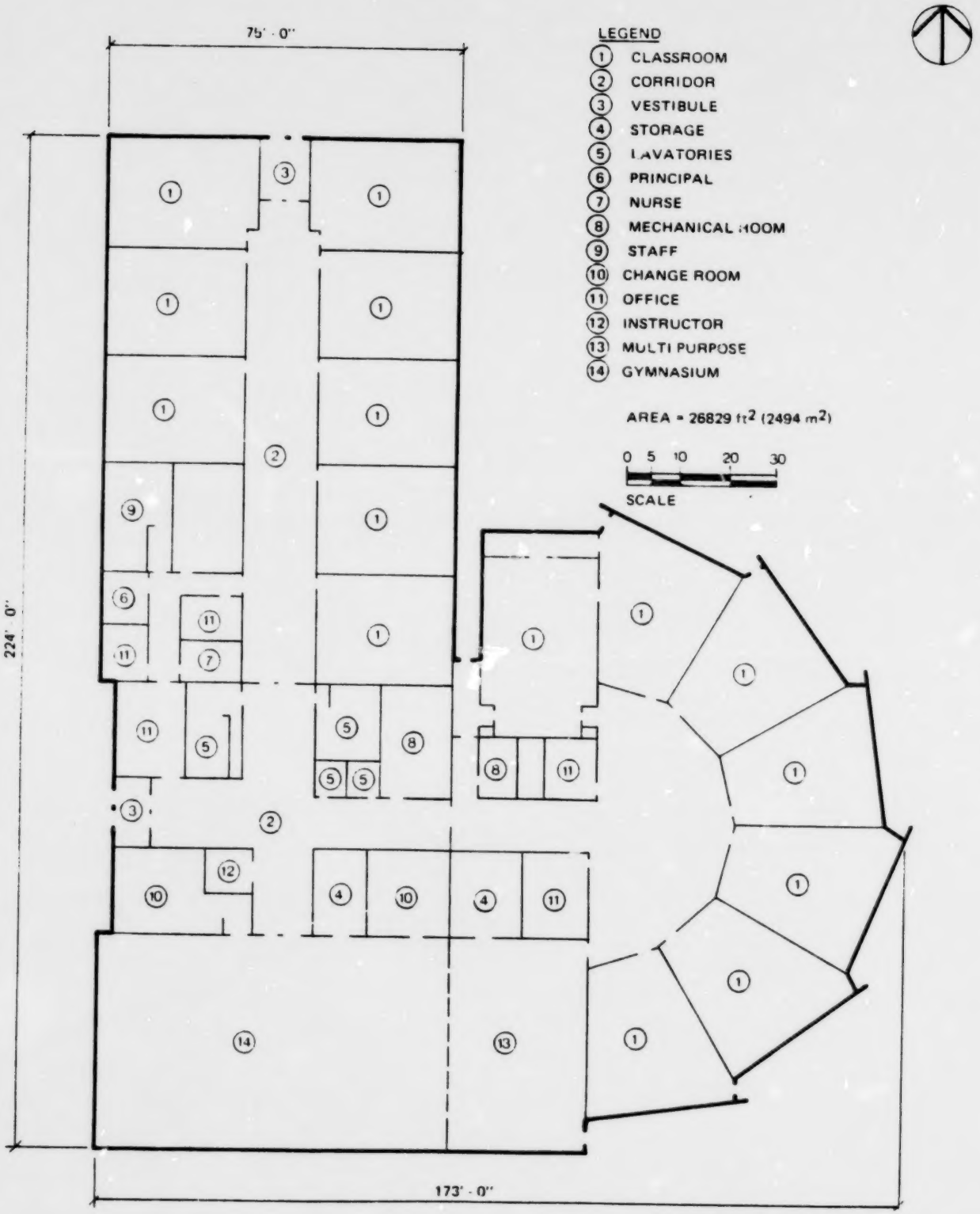
7. Science Laboratory Lighting (new section) - The lighting level was measured at approximately 1,184 - 1,399 lux (110-130 foot candles). It was recommended that this level be reduced to 1,076 lux (100 foot candles) by disconnecting 4 fixtures down the centre of the room (but not at the chalkboard).

8. Gym Incandescent Lights - The gym has 15 - 400 watt mercury fixtures as well as 12 - 300 watt incandescent fixtures. The light level was measured at 377 - 592 lux (35 to 55 foot candles). The recommended light level is 323 lux (30 foot candles). To reduce the levels, it was recommended that 8 of the 12 incandescent fixtures be disconnected permanently. The remaining four fixtures were to be equipped with a timer control to act as a standby to the mercury lights. The timer control acts to shut these lights off after the mercury lighting has come up to full brightness.

The following retrofits with payback periods greater than five years were also noted for installation:

1. Corridor Incandescent Lights - It was recommended that the incandescent fixtures be removed and replaced with two lamp surface mounted fluorescent fixtures (total of twelve required). The cost effectiveness of this measure is increased by using existing fixtures from other areas of the school which are no longer required.

2. Demand Control - Since the school is equipped with a central computer control system, it was recommended that this system be adapted to provide demand control. The major loads within the school were to be connected to the system (hot water heater and the electric heating) with an additional ten control points. Cost savings shown in the table were based on the assumption that 28 KVA of demand could be eliminated. This will depend on operating conditons but is likely conservative.



ENERSCHOOL PROGRAM
ERICKSON COLLEGIATE, ERICKSON

FIGURE 9

TABLE 22
ERICKSON COLLEGIATE
ERICKSON
ROLLING RIVER SCHOOL DIVISION NO. 39

RECOMMENDED RETROFIT OPTIONS
(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Hot Water Tank	57.2°C	43.3°C	Reduce Temperature by 13.9°C	0	4,100	53	0
*2.	Gym Ventilation Unit	Normal Controlled Operation	Ctl. Fresh Air Based on Occuancy	Install Timer to Determine Occupied/Unoccupied Periods and Reduce Fresh Air When Unoccupied.	500	25,900	700	0.7
*3.	Exh. Fans F1, F2, F4, F12, F15	Manual Ctl.	Timed Control	Install Timer to Reduce Operating Period	1,500	62,500	1,650	0.9
*4.	Corridor Ventilation Unit	Continuous Operation	Timed Control	Connect to Central Computer and Control Based on Occupancy	1,000	38,800	1,000	1.0
*5.	MPR Room Lighting	Excessive Levels	753 Lux	Disconnect 12 Fluorescent Fixtures	105	2,800	100	1.1
*6.	Gym Relief Fans	Manual Control	Install Controlled Relief Hood	Remove Gym Relief Fans and One Inlet Damper and Install Motorized Damper and Relief Hood at Remaining Inlet Damper Location. Control from Mixed Air of Gym Ventilation Unit.	2,000	62,800	1,700	1.2
*7.	Science Lab Lighting	1184-1399 Lux	1076 Lux	Disconnect 4 Fixtures in Centre Area	50	940	33	1.5
*8.	Gym Inc. Lights	All On	Reduce	Disconnect 8 Fixtures and Time Control Remainder to Shut Off After Mercury Fixtures are On.	525	9,100	315	1.7
*9.	Crawlspace	Wet and Vented	Regrade and Close Off	Regrade around Old Building and Close off Vents in Winter	2,400	45,500	1,230	2.0
	Total Estimated Implementation Cost				$8,080			
	Total Cost Saving				6,781			
	Payback				1.2 Years			
	Capital Budget 2,494 m^2 x $3.55/$m^2$				8,855			

* RECOMMENDED RETROFIT

TABLE 23

ERICKSON COLLEGIATE
ERICKSON
ROLLING RIVER SCHOOL DIVISION NO. 39

POSSIBLE RETROFIT OPTIONS
(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
1.	Corridor Inc. Lights	All Incandescent	Use Fluorescent	Replace Incandescent Fixtures with Fluorescent Fixtures) (12 - 2 Lamp Fixtures	245	6,200	1,400	5.7
2.	Demand Ctl.	Uncontrolled Demand	Limit Electric Demand	Utilize Central Computer to Control Electric Loads Including Heating Loads	5,200	(18 kVA)	775	6.7
3.	Steam Boiler	Oil Fired Heating of Oil Building	Hybrid Oil and Electric	Replace about 1/3 of Existing Oil Capacity with Electric Heating.	17,000	73,900	2,000	8.5

CENTENNIAL ELEMENTARY SCHOOL

CENTENNIAL ELEMENTARY SCHOOL, LAC DU BONNET

Building Description

Centennial School was built in 1967 and consists of 8 classrooms, an auditorium and related washrooms and teacher areas.

The total school area is 1,288 square metres with an exterior perimeter of 168 metres.

The building is a single level structure with a heated crawl space. The construction drawings indicate the crawl space is clad with 38.1 mm (1 1/2") insulation. None was seen during the inspection.

The majority of the wall construction consists of 101.6 mm (4") stone, an air gap, and 203.2 mm (8") concrete block filled with insulation (RSI 0.7/R4).

The gymnasium roof is a built-up roof with 38.1 mm (1 1/2") rigid insulation on 19.1 mm (3/4") diagonal sheathing and wood trusses (RSI 0.7/R4).

The main schoolroom is insulated with RSI 1.2 (R7) insulation supplemented with 38.1 mm (1 1/2") vermiculite (RSI 1.8/R10).

The windows represent about 10% of the wall space and are double glazed.

It should be noted that the RSI/R values indicated are based on the combined insulation value of the wall or roof assembly.

The school mechanical system consists of a central air handling unit which mixes fresh and outside air and distributes it throughout the building. Individual hot water reheat coils in the duct work provide local zone control. A central fuel oil fired boiler provides the hot water to the heating coils and miscellaneous convectors.

Old School: 101.6 mm (4") face brick, air space, 38.1 mm (1 1/2") rigid insulation, vapour barrier and concrete block (RSI 1.3/R7.5).

The roof construction is as follows:

New School:

Classroom Area built up roof, 25.4 mm (1") rigid insulation, vapour barrier, 76.2 mm (3") plant tectum, on glu-lam beams with 101.6 mm (4") of urethane foam (RSI 3.5/R20 average).

Multi-purpose Area - built-up roof, 38.1 mm (1 1/2") rigid insulation, vapour barrier, 38.1 mm (1 1/2") steel deck, steel joists and 101.6 mm (4") of urethane foam (RSI 4.2/R24).

Old School:

Gymnasium Area - built-up roof, 38.1 mm (1 1/2") rigid insulation, 38.1 mm (1 1/2") steel deck, steel joist (RSI 1.1/R6.5).

Remainder - built-up roof, 38.1 mm (1 1/2") rigid insulation, 19.1 mm (3/4") shiplap, 50.8 mm x 355.6 mm (2" x 14") joists, 25.4 mm x 76.2 mm (1" x 3") strapping, 12.7 mm (1/2") acoustic tile (RSI 1.1/R6.5).

The crawl space and grade beams have 25.4 mm (1") rigid insulation on the interior perimeter around the entire school.

The windows are either double or triple glazed construction.

It should be noted that the RSI/R values indicated are based on the combined insulation value of the entire assembly.

The old school mechanical system consists of a central fan system with steam heating coil for the gymnasium area. The old school area classrooms are heated and ventilated via individual unit ventilators. Additional room areas are heated via individual radiation units or force flows. Relief ventilation is provided in the corridor of the old school as well as the gym. Steam supply is from a central oil fired steam boiler rated at 615 kW (2,100,000 BTU/hr). Miscellaneous exhaust fans are present in the old school area for washroom and storage rooms.

The new school mechanical system consists of a central fan system with individual zone electric duct heating coils (approximately 85 kw capacity). Additional heating is supplied via electric perimeter radiation or fan forced electric units.

Domestic hot water is provided with a 454.6 litres (100 gallon), 9 kw electric hot water tank.

The electric service is provided at 120/208V, 3 phase, 4 wire through a 1200 A main breaker and 1200 A central distribution panel. Individual building loads are provided from this panel as well as the supply to the existing distribution in the old school. Power is metered by a single meter and charged at the "Power Standard Rate" by Manitoba Hydro.

The lighting in the old school is provided with fluorescent fixtures in the classrooms and incandescent in the corridors. The gymnasium has a combination of mercury vapour and incandescent fixtures. The new school lighting is fluorescent.

Exterior lighting is mercury vapour and a few incandescent fixtures.

Energy Consumption

Annual energy consumption was as follows:

Oil	523,530 kWh
Electricity	109,415 kWh
Total Annual Consumption	632,945 kWh
Energy Index	491 kWh/m^2/a

Retrofit Measures

The total capital budget identified for Centennial Elementary School is $4,575.00 compared to a total estimated value for the recommended retrofit items of $7,610.00. The retrofit options selected by the school are items 1, 2, 3, 4, 5 and 7. The total capital cost of these items exceeds the capital budget with the cost difference being the obligation of the school. Details are shown in Tables 24 and 25. A brief description of the selected retrofit items is as follows:

1. The weatherstripping on the exterior doors was in poor shape. It was recommended this be repaired.

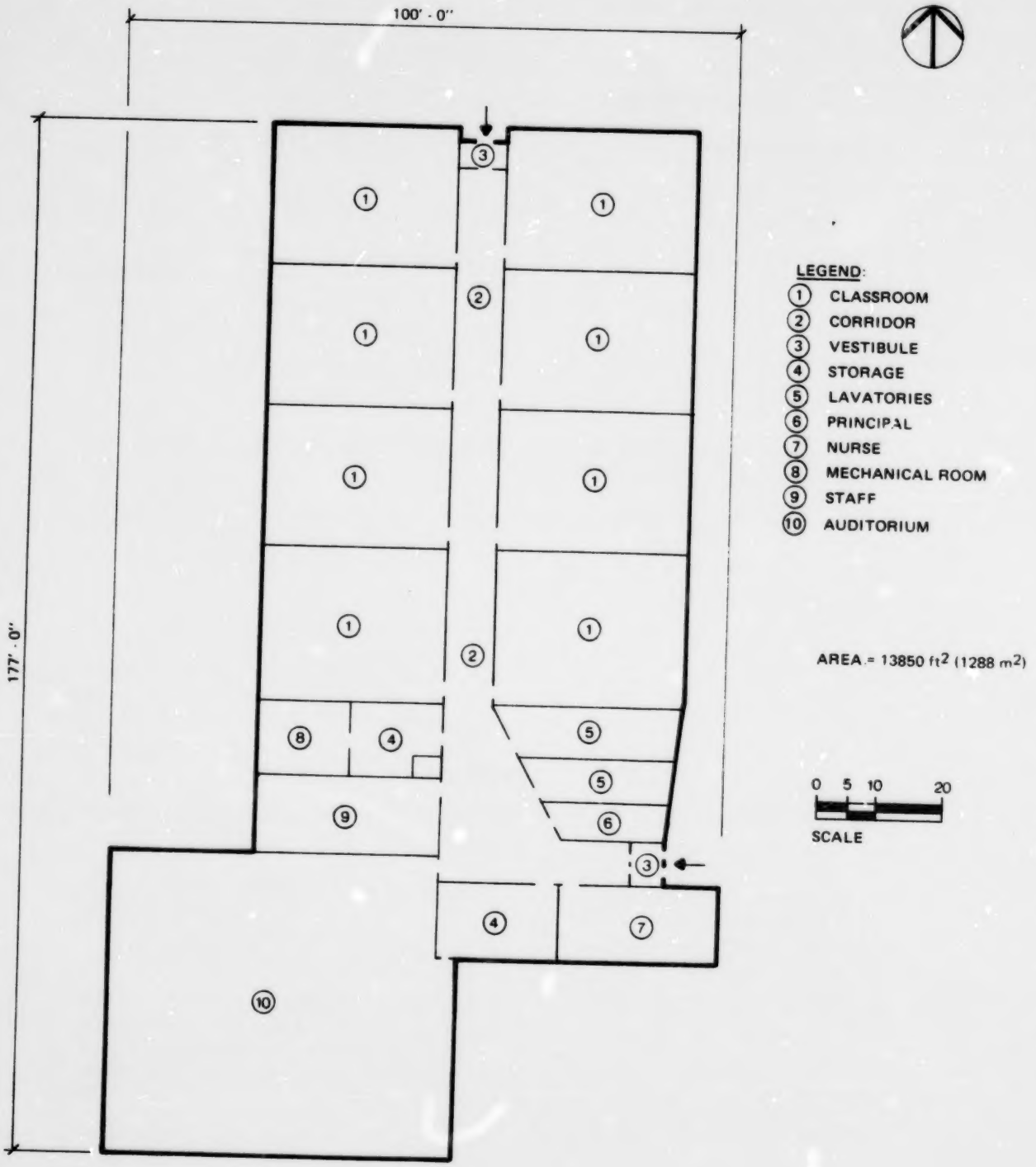
2. The central exhaust fan servicing the washrooms ran continuously during the school year. It was recommended that a time clock be installed to reduce the total run time to 4 hours per day with operation during use periods only.

3. The outside air damper operator on the air handling unit was not functioning. It was recommended this be repaired. With the damper operator inoperative, the damper left in a 10% outside air position, 661 litres/second (1400 CFM) of cold air was being brought in continuously. The existing night setback feature which should close off the dampers could not function. The extra energy consumed during non school hours was estimated at $3,000 per year.

4. The lighting in the corridors was excessive and the recommendation was made that it be reduced by disconnecting every second fixture.

5. The air handling unit ran 24 hours a day from September to June. It was recommended that it be placed on a time clock with an outside air temperature override. The savings shown in the table are for the power consumed by the motor. No heating energy will be saved.

6. The school was found to have a significant moisture problem in the crawl space. This was largely due to the poor drainage around the perimeter. An earth berm was recommended for the perimeter of the building and the downspouts were to be extended. It was also recommended that the crawl space grade beam be insulated and the vents sealed off in winter.



ENERSCHOOL PROGRAM
CENTENNIAL SCHOOL, LAC DU BONNET

FIGURE 10

TABLE 24

CENTENNIAL ELEMENTARY SCHOOL
LAC DU BONNET
AGASSIZ SCHOOL DIVISION NO. 13

RECOMMENDED RETROFIT OPTIONS
(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Weather-strip Doors	Poor Weather-stripping	Good Weather-stripping	Install Weatherstripping	120	42,406	$1,113	0.1
*2.	Place Exhaust Fan on Timer	Continuous Operation	Timed Operation	Install a Timer on the Fan Circuit	250	26,670	700	0.4
*3.	Repair Out-side Air Dampers on Air Handling Unit	Inoperable	Repaired	Repair Damper Operator and Linkage	2,400	114,300	3,000	0.8
*4.	Reduce Corridor Lighting Levels	538 Lux	215 Lux	Disconnect Every Second Hallway Fixture	100	2,030	70	1.4
*5.	Reduce the Run Time on Air Handling Unit	Continuous Operation	Timed Operation	Put Air Handling Unit on Time Clock With Outside Air Override Below 12.8°C	500	6,520	225	2.2
6.	Shift 50% of Heating load to Electrical	Totally Oil Heat	Partially Oil Heat	Install a 50 kW Electric Boiler	8,000	0	$2,900	2.8
*7.	Improve Building Drainage and Crawlspace Insulation	Poor	Improved	Construct an Earth Berm Around School Perimeter; Extend Roof Drainage; Re-insulate Crawlspace	4,400	34,630	900	5.0
	Total Estimated Implementation Cost				$7,610			
	Total Cost Saving				6,008			
	Payback				.8 years			
	Capital Budget		1,287 m^2 x $3.55/$m^2$		4,570			

* RECOMMENDED RETROFITS

TABLE 25

CENTENNIAL ELEMENTARY SCHOOL
LAC DU BONNET
AGASSIZ SCHOOL DIVISION NO. 13

RECOMMENDED RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
1.	Improve Attic Insulation	RSI 0.9 (R5)	RSI 3.5 (R20)	Remove Existing Lights and Acoustic Tile. Add Vapour Barrier, New Drywall and Paint. Add RSI 3.5 (R20) insulation in Ceiling	46,150	176,185	$4,624	10.0

McCREARY SCHOOL

McCREARY SCHOOL - McCreary

Building Description

McCreary School was constructed in two phases. The initial building was constructed in 1960 and consists of 5 classrooms, a science laboratory, a library, an auditorium, washrooms and associated teacher areas. Phase II was built in 1978 and consists of 5 classrooms, an industrial arts room, a home economics room, business education centre, a kindergarten area, a library, a gymnasium, and associated teacher areas.

The total school area is 3,346 square metres with an exterior perimeter of 277 metres.

Both buildings are single level structure with crawl spaces.

The Phase I building wall construction consists of 50.8 mm x 101.6 mm (2" x 4") studs with 76.2 mm (3") batt insulation (RSI 1.8/R10). The Phase II building wall construction consists of 101.6 mm (4") face brick, air space, 53.3 mm (2 1/2") rigid insulation vapour barrier and 254.0 mm (10") concrete block (RSI 1.8/R10).

The roof of the Phase I building has 38.1 mm (1 1/2") rigid insulation (RSI 1.1/R6), while the roof of the Phase II building has 101.6 mm (4") rigid insulation on steel decking (RSI 3.5/R20).

The interior of the crawl space is lined with 50.8 mm (2") rigid insulation (RSI 1.4/R8).

It should be noted that the RSI/R values are based on the combined insulation value of the assembly.

The windows in the Phase I building are double glazed while in the Phase II building the windows are triple glazed.

The Phase I mechanical system consists of a central oil fired steam boiler which feeds individual unit ventilators in each classroom. The unit ventilators consist of a fan, a steam coil, and a modulating damper which controls the return air and fresh air dampers. The boiler also feeds convector cabinets and air handling unit heating coils. The auditorium is heated and ventilated with an air handling unit which brings in fresh air.

One 454.6 litre (100 gallon), 6,000 W hot water storage tank supplies domestic hot water. There is no domestic hot water recirculating system.

The Phase II mechanical system consists of a central electric hot water boiler feeding fan coils, force flows, convectors, and heating coils. A central fan system with fresh air make-up and a hot water heating coil feeds individual variable volume boxes in the classrooms. The variable volume boxes are interlocked with the fan coils to give zone control. The industrial arts area is heated and ventilated with its own air handling unit. The business education area and the home economics area are cooled and ventilated with a common air handling unit and accompanying VAV boxes. The administrative area is also cooled and ventilated with a separate air handling unit. The gymnasium is heated and ventilated by its own air handling unit.

Domestic hot water is provided by 3 - 454.6 litre (100 gallon), 18 kW electric water heaters.

The electrical system is rated at 347/600V, 3 phase, 4 wire, 800 A.

The interior lighting is predominantly fluorescent with mercury vapour lighting in the gymnasium.

Energy Consumption

Annual energy consumption was as follows:

Oil	489,600 kWh
Electricity	608,400 kWh
Total Annual Consumption	1,098,000 kWh
Energy Index	328 kWh/m^2/a

Retrofit Measures

The total capital budget identified for McCreary School is $11,880.00 compared to an estimated total cost for the recommended retrofit items of $14,547.00. The retrofit options selected by the school which are priced within the capital budget include all of the items with a five year or less payback period except for Item 12. Details are shown in Tables 26 and 27. A brief description of the selected retrofit items is as follows:

1. The lighting observed in the gymnasium provided 646 to 700 lux (60-65 foot candles). Present standards recommend 323 lux (30 foot candles). It was therefore recommended that six 400 W mercury vapour fixtures be turned off at the distribution panel (circuits 3 and 4).

2. The incandescent standby lighting in the gymnasium was found to be excessive. It was recommended that the 8 lamps be changed from 400 W to 200 W.

3. One of the classroom unit ventilators in the old building was not functioning. The steam valve was in the open position while the room thermostat was in the satisfied position. This resulted in outside air being brought in to cool the room. If this condition were to be allowed to continue for one heating season, the additional heating cost would be $127.00. The valve was recommended for replacement. The fan motor was also in need of repair. This indicated a need for ongoing maintenance.

4. Upon examining the billing information it became apparent that the demand controller was not functioning. The highest demand peak occurred in the summer months. This was illogical as the air conditioning connected load was only 400 kW while the connected heating load was 450 kW. The billing data showed a peak winter load of 268 kW while summer loads were typically 384 kW. Since air conditioning and peak heating should never occur at the same time the maximum demand should be the winter heating load plus the normal lighting and power usage. Based on a value of general lighting power of 2 watts per square foot as being representative of the schools studied, the heating load is reduced to 196kW. That is to say that the hot water boiler appears to be considerably oversized. Out of 450 kW capacity only 196 kW maximum was ever put to use. The demand controller was set up to shed the last 180 kW of load. Since this level was never reached the controller effectively did not function. It was recommended that the scheme of load shedding demand control be re-evaluated and the reason for the high summer peak demands be investigated. The high summer peak demands were possibly due to some maintenance or operation function. The savings shown in Item 4, Table 26 are representative of reducing the summer demands to the winter peak of 268 kW. If the summer demand consisted of the normal load indicated on the drawings (air conditioning, domestic hot water, general lighting and power) a further saving of $1,752 could be realized.

5. The exhaust fans ran continuously. It was recommended that timers be placed on these fans to shut them down when the school is unoccupied.

6. The lighting in the corridors of the open elementary area was excessive and it was recommended that the level be reduced by physically disconnecting 13 fixtures.

7. The lighting in the general open elementary area was similarly greater than recommended levels. To reduce the light level it was recommended that one two lamp ballast be disconnected in 35 of the existing fixtures.

8. At the time of the inspection several air handling units were supplying air to the spaces at temperatures higher than required. The temperature of the spaces exceeded the set point of the thermostat. The systems are designed to operate with a supply air temperature of 12.8°C (55°F). Values found are shown below:

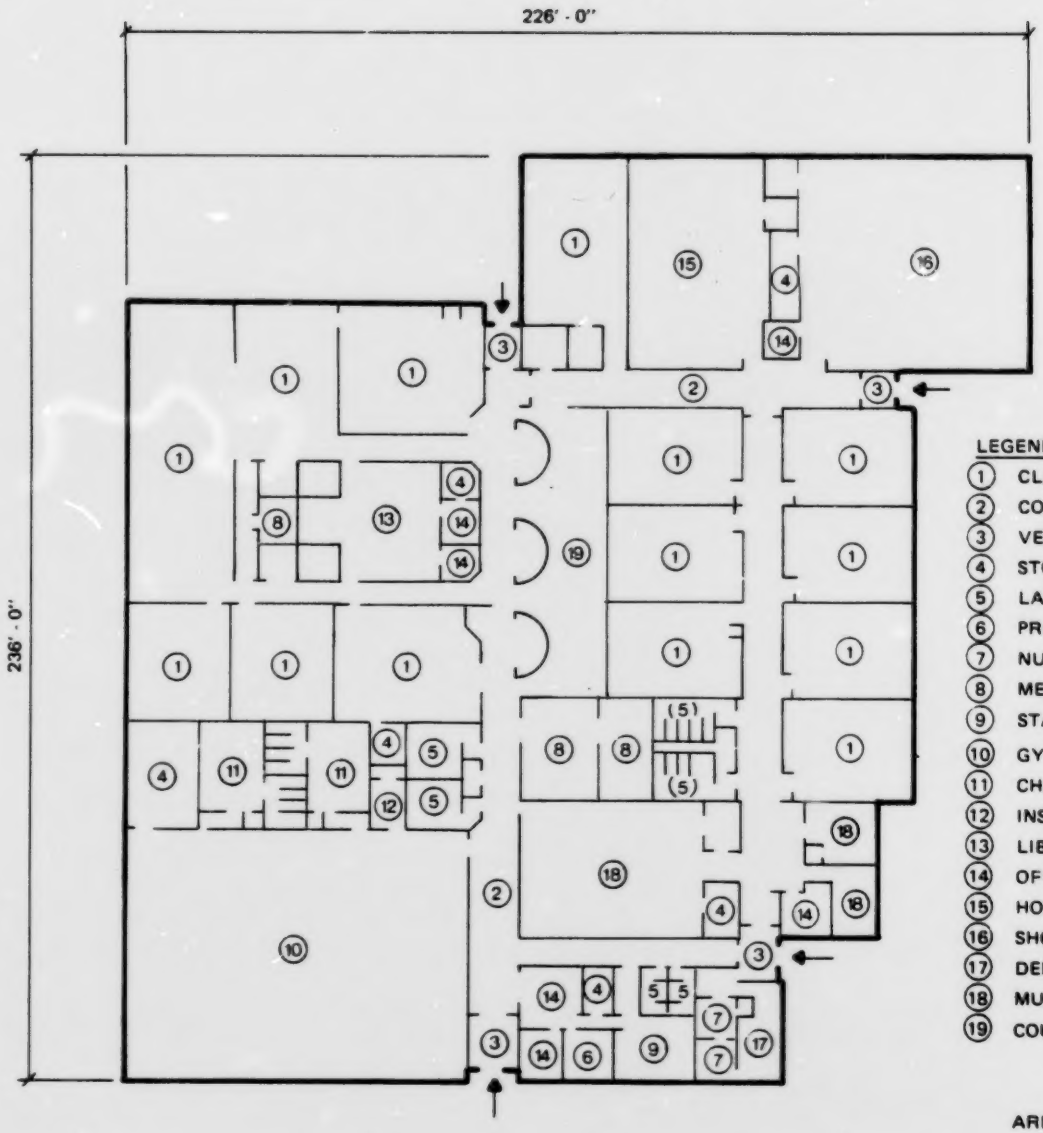
Gymnasium:		
Space temperature	21.1°C (70°F)	
Supply air	17.8°C (64°F)	
Mixed air	14.4°C (58°F)	(should be at least 17.8°C (64°F), ie. no heating at unit)
Classroom:		
Space temperature	23.3°C (74°F)	(should be no more than 21.1°C (70°F).
Supply air	17.8°C (64°F)	
Mixed Air	14.4°C (58°F)	(should both be at approx. 14.4°C (58°F), ie. no heating)
Industrial Art:		
Space temperature	20.0°C (68°F)	
Supply air	28.9°C (84°F)	
Mixed air	20.0°C (68°F)	(should be at least 20.0°C (68°F), ie, no outdoor air)

Heating the supply air by unit coils should be kept to a minimum by reducing the amount of fresh air being brought into the building. In the gymnasium alone one 10 hour day of operation at the above condition will cost $2.70. The savings in the table are based on one heating season. To realize the above savings it was recommended that a controls contractor be hired to recommission the controls on all five air handling systems.

9. The lighting in the old building classrooms was excessive and it was recommended that 3-2 lamp fixtures be disconnected in each of the 6 classrooms.

10. The home economics area also was overlit and it was recommended that 16 lamps and 8 ballasts be disconnected.

11. The incandescent standby lighting in the gymnasium operated continuously. It was recommended that these lights be controlled by a timer to shut them off 10 minutes after power is supplied to the mercury vapour lights.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. GYMNASIUM
11. CHANGE ROOM
12. INSTRUCTOR
13. LIBRARY
14. OFFICE
15. HOME ECONOMICS
16. SHOPS
17. DENTAL
18. MULTI PURPOSE
19. COURT YARD

AREA = 36000 ft^2 (3346 m^2)

0 10 20 40

SCALE

ENERSCHOOL PROGRAM
McCREARY SCHOOL, McCREARY

FIGURE 11

TABLE 26

McCREARY SCHOOL
McCREARY
TURTLE RIVER SCHOOL DIVISION NO. 32

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Gymnasium Lighting	646-700 Lux	323 Lux	Turn off 6-400W Mercury Vapour Fixtures	0	5,607	220	0.
*2.	Gymnasium Lighting	500W	200W	Reduce Lamp Wattage in Standby Incandescent Lighting	45	5,040	198	0.2
*3.	Repair and Maintain Unit Ventilator and Associated Controls	Damaged	Maintained	Replace Blower Motor and Steam Control Valve in One Classroom Set Up O.A. Damper to 16% Fresh Air	285	4,687	127	0.5
*4.	Investigate and Set Up Demand Controller Operation	Inoperative	Reset Controls	Verify Operation and Revise Load Shedding Schedule and/or School Operation	2,000	0	3,517	0.6
*5.	Place Exhaust Fans on Timers	Manual Control	Timer Control	Place Exhaust Fans E2, E4, F 7, F 10 and F 13 on 7 Day Timers	900	59,063	1,091	0.8
*6.	Reduce Corridor Lighting in Open Elementary Area	969 Lux	215 Lux	Disconnect 12 Fluorescent Fixtures	117	2,593	102	1.2
*7.	Reduce Lighting in Kindergarten, Science and Open Elementary Area	969 Lux	753 Lux	Disconnect One 2 Lamp Ballast in 35 4 Lamp Fluorescent Fixtures	350	6,993	275	1.3

TABLE 26 (Continued)

McCREARY SCHOOL
McCREARY
TURTLE RIVER SCHOOL DIVISION NO. 32

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*8.	Set Up Air Handling Unit Controls	Misadjusted	Recommission	Re-establish Proper Control Sequences on Air Handling Units	500	29,268	360	1.4
*9.	Reduce Lighting in High School (Old Building) Classrooms	969 Lux	753 Lux	Disconnect 3 2 Lamp Fixtures in 6 Classrooms	200	3,591	140	1.4
*10.	Reduce Lighting in Home Economics Area	1292 Lux	1076 Lux	Remove 16 Lamps and 8 Ballasts in Home Economics Area	100	1,596	$ 60	1.7
*11.	Gymnasium Lighting	Continuous Operation	Timed Operation	Put Standby Incandescent on a 10 Minute Timer	350	3,360	132	2.7
*12.	Replace Fuel Oil Boiler with Electric	Oil Fired	Electric Fired	Replace Fuel Oil Steam Boiler with Electric Boiler. Existing Service is Large Enough	9,700	0	2,720	3.6
	Total Implementation Cost				$14,547			
	Total Cost Saving				8,942			
	Payback				1.63 Years			
	Capital Budget	3,345 m^2 x $3.55/$m^2$			11,880			

* RECOMMENDED RETROFIT

TABLE 27

McCREARY SCHOOL
McCREARY
TURTLE RIVER SCHOOL DIVISION NO. 32

RECOMMENDED RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
1.	Close in Windows in Courtyard Except Science Room	Excessive Window Area	Reduce Window Area	Close in Windows with 50.8x101.6mm (2"x4")Studs, RSI 2.1 (R12) Insulation. Interior and Exterior Finish to Match	1,500	6,638	290	5.2
2.	Reroof Phase I Building and Insulate to RSI 3.5 (R20)	RSI 0.9 (R5)	RSI 3.5 (R20)	Remove Old Roof and Replace with New Roof. 101.6 mm (4") SM Board Insulation RSI 3.5(R20)	41,500	172,098	4,516	9.2

MINITONAS INTERMEDIATE SCHOOL

MINITONAS INTERMEDIATE SCHOOL - Minitonas

Building Description

Minitonas School, one of the smallest of the rural schools in the program, was constructed in 1962. The school is composed of 8 classrooms, a laboratory, auditorium with showers, washrooms and teacher areas.

The total school area is 1,632 square metres with an exterior perimeter of 191 metres

The building is a single level structure with no crawl space.

Wall construction consists of 101.6 mm (4") brick face and 203.2 mm (8") concrete block filled with vermiculite (RSI 0.6/R3.5) in the classroom area and 101.6 mm (4") exterior block and 203.2 mm (8") concrete block filled with vermiculite (RSI 0.6/R3.5) in the gym area.

The roof consists of 4 ply built up roofing with 50.8 mm (2") of rigid fibre board insulation on steel decking (RSI 1.1/R6).

The interior grade beam has a continuous run of 50.8 mm (2") aerofoam insulation.

The windows are all double glazed units.

It should be noted that the RSI/R values are based on the combined insulation value of the assembly.

The school mechanical system consists of a central oil fired hot water boiler with an approximate output capacity of 732 kW (2500 MBH). This unit supplies hot water for the unit ventilators, perimeter radiation, foyer unit heaters and central fan system heating coils. Central fan systems are provided for the gymnasium and the laboratory.

Relief dampers are provided for the laboratory, gymnasium and corridor.

Individual classrooms are heated with unit ventilators equipped with fresh and return air dampers and individual room thermostats.

The electrical system is rated at 120/208V, 3 phase, 4 wire, 600 amperes and has three separate electric meters. All the electric meters are on the general service rate.

Lighting is a mixture of fluorescent fixtures in the classrooms, and incandescent fixtures in the gymnasium and corridors.

Energy Consumption

Annual Energy consumption was as follows:

Oil	623,238 kWh
Electricity	93,046 kWh
Total Annual Consumption	716,284 kWh
Energy Index	439 kWh/m^2/a

Retrofit Measures

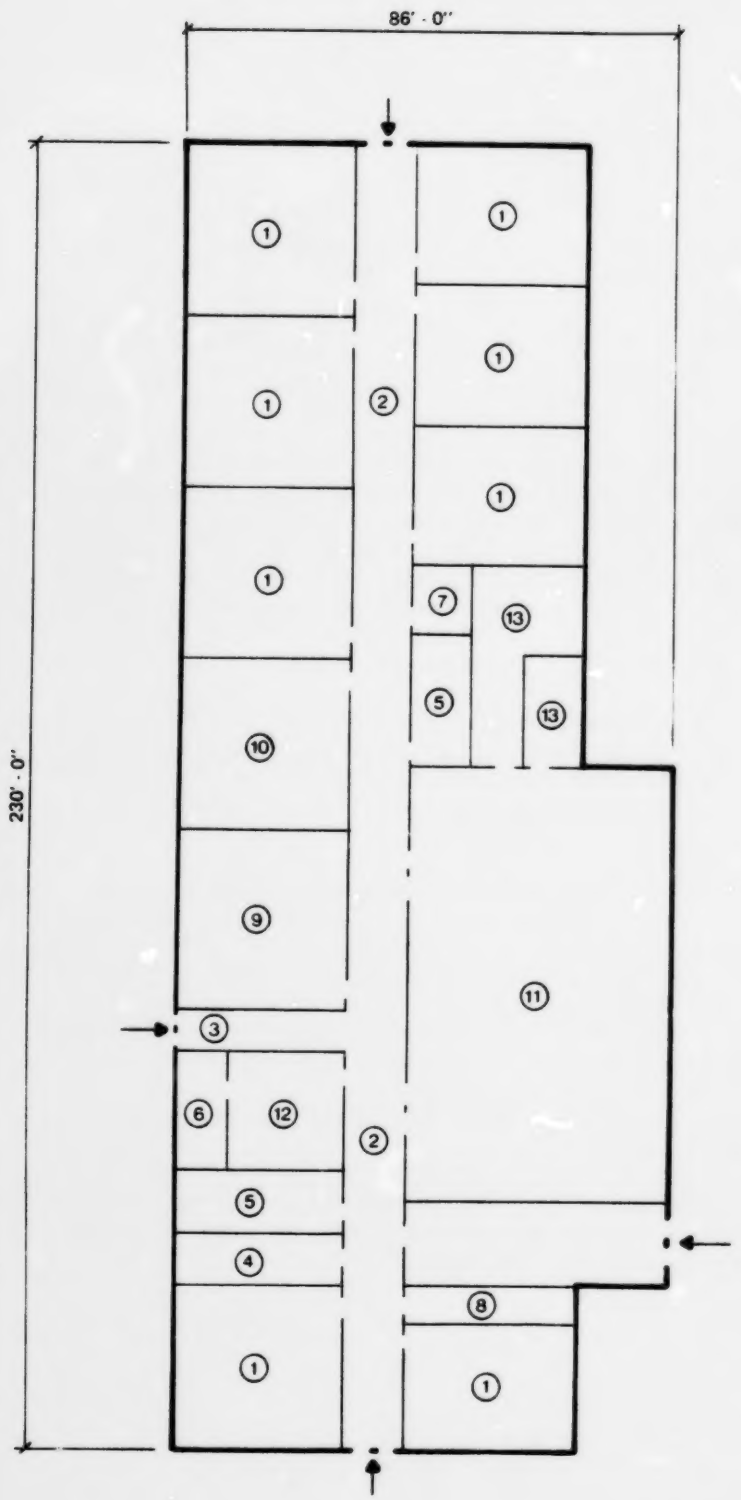
The total capital budget identified for Minitonas Intermediate School is $5,795.00 compared to an estimated total cost for recommended retrofit items of $5,280.00. The retrofit options selected by the school with a 5 year or less payback period are Items 1, 2, 4 and 8. Retrofit item 8 was implemented in conjunction with extensive remodelling of the east and west walls of the building with costs exceeding the capital budget. A brief description of the selected retrofit items listed in Tables 28 and 29 are as follows:

1. Hot Water Tanks - The tanks were set at 65.6°C (150°F). It was recommended that this temperature setting be reset to 48.9°C (120°F) to affect the savings indicated in Table 28. The resulting hot water quality is not affected by the reduced temperature setting.

2. Corridor Relief Damper - The relief opening in the corridor ceiling is intended to relieve the air being introduced into the building by the unit ventilators. However, this releases a considerable amount of heat in the process. It was therefore recommended that the damper and controls be removed and the opening in the roof closed off. With the changes the relief of the building will occur by exfiltration from the building.

4. Doors - It was noted that the door weatherstripping was not satisfactory and needed repair.

8. Windows - It was recommended that the window area on the school be reduced by removing windows and blanking off the area to match the exterior and interiors of the building.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. LIBRARY
11. AUDITORIUM
12. OFFICE
13. CHANGE ROOM

AREA = 17556 ft^2 (1632 m^2)

0 10 20 40

SCALE

ENERSCHOOL PROGRAM
MINITONAS SCHOOL, MINITONAS

FIGURE 12

TABLE 28
MINITONAS INTERMEDIATE SCHOOL
SWAN VALLEY SCHOOL DIVISION NO. 35

RECOMMENDED RETROFIT OPTIONS
(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Hot Water Tanks	65.6°C	48.9°C	Reduce Temperature by 16.7°C	0	7,900	257	0
*2.	Corridor Relief Damper	Controlled Relief	Delete	Remove Damper and Seal Roof Opening	250	184,700	4,700	0.1
*3.	Unit Ventil-ation	Malfunctioning Ctl. Valve	Replace	Service Unit Ventilators to Ensure Proper Operation (9 units)	250/unit	58,000/unit	1,475/unit	0.2/unit
*4.	Doors	Unsealed	Seal	Weatherstrip Doors	200	30,450	775	0.3
*5.	Hall Inc. Light Fixtures	323-431 Lux	215 Lux	Replace all 150W Bulbs with 60W Bulbs	30	2,700	90	0.3
*6.	Exhaust Fans F2, F3 and F4	Manual Control	Timed Control	Provide Units with Manual Reset Timers	900	61,000	1,550	0.6
*7.	Vestibule Inc. Lights	150W	75W	Replace Vest. and Exterior Light Bulbs with 75W Size and Place on Timer	150	3,500	120	1.3
*8.	Windows	Excessive Area	Reduce Area	Blank Off 50% of Window Area				
				Method #1: - Window Remains, Blank Off Interior to match	1,500	30,000	1,200	1.3
				Method #2: - Remove Window and Blank Off to Match Exterior and Interior	3,500	30,000	1,200	2.9
9.	Oil Fired Boiler	Old Boiler	New Boiler	Replace Existing Oil Fired Boiler with New Boiler of Correct Size	10,000	165,000	4,200	2.4
10.	Boiler	Oil Fired	Combined Oil and Electric	Install Companion 60 KW Electric Boiler and Operate Oil for Peak Loads	10,000	130,000	3,700	2.7

Total Estimated Implementation Cost		$ 5,280
Total Cost Saving		21,967
Payback		0.24 years
Capital Budget	1,632 m^2 x $3.55/$m^2$	5,795

* RECOMMENDED FOR RETROFIT

TABLE 29

MINITONAS INTERMEDIATE SCHOOL
MINITONAS
SWAN VALLEY SCHOOL DIVISION NO. 35

RECOMMENDED RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
1.	Parking Plugs	Uncontrolled	Controlled	Control Bus Heaters with Time Clock and Thermostat	1,000	3,900	135	7.4
2.	Gym Lights	Incandescent	High Pressure Sodium	Replace Inc. Fixtures with High Pressure Sodium Fixtures to Improve Light Level, Reduce Energy Use and Maintenance Costs.	5,700	19,000	660	8.6

NEELIN HIGH SCHOOL

NEELIN HIGH SCHOOL - Brandon

Building Description

Neelin High School is the largest of the eight rural schools in the program. The school was constructed in three phases. The original school, consisting of seven classrooms, science room, library, craft sewing room, home economics, drafting room, shops, auditorium, washrooms and offices, was constructed in 1956. In 1966 the gymnasium was expanded and provided with shower and change facilities and classroom and laboratory areas were added. This addition resulted in the formation of a central outdoor courtyard. Finally, in 1976, the third phase of construction occurred with the addition of a new gym and change facilities and a conversion of the existing gym area into a material resource center and music room. This addition formed a second outdoor courtyard. The total school area is 6,399 square metres with an exterior perimeter (exluding courtyard) of 413 metres.

The building is a single level structure with a crawl space under most of the school except the old gymnasium and the shops area. The crawl space is uninsulated in the older areas. The crawl space under the new gym is insulated with rigid styrofoam.

The building constructed in 1956 has 50.8 mm (2") of batt insulation in the wall (RSI 1.8/R10) and 38.1 mm (1 1/2") of rigid insulation in the ceiling (RSI 1.8/R10). The windows are of dual pane construction.

The 1956 addition has for the most part 38.1 mm (1 1/2") of rigid insulation in the wall (RSI 1.4/R8) with some areas as low as 25.4 mm (1") of rigid wall insulation (RSI 1.2/R7). The ceiling has 38.1 mm (1 1/2") of rigid insulation (RSI 2.1/R12). The windows for the most part are of dual pane construction. The 1976 addition has 63.5 mm (2 1/2") of rigid insulation in the walls (RSI 2.3/R13) and and 76.2 mm (3") of rigid insulation in the ceiling (RSI 2.8/R16). The windows are of dual pane construction.

It should be noted that the RSI/R values indicated are based on the combined insulation value of the wall material, brick face, concrete block and insulation. This data was obtained from the construction drawings provided.

The school mechanical system consists of a number of centralized fan systems throughout the building with hot water heating coils and supplemented by individual radiators. Individual unit ventilators are installed in the 1966 addition classrooms.

Domestic hot water is provided by four electric heater units and one gas fired unit.

The electrical service for the facility consists of a single 1200A, 120/208V, 3 phase service and associated distribution. Lighting for the most part is based on fluorescent fixtures with some incandescent in the halls and mercury vapor in the gymnasium.

Energy Consumption

Annual energy consumption was as follows:

Natural Gas	2,099,925 kWh
Electricity	309,825 kWh
Total Annual Consumption	2,409,750 kWh
Energy Index	377 kWh/m^2/a

Retrofit Measures

The total capital budget identified for Neelin High School is $22,720.00 compared to an estimated total cost for recommended retrofit items of $20,225.00. The retrofit options selected by the school with a 5 year or less payback period and priced within the capital budget are Items 1, 4, 5, 6, 9 and 10. A description of the selected retrofit items listed in Tables 30 and 31 are as follows:

1. Hot Water Tank Temperature - The settings of the electric 28 kW tanks were observed to be 65.6°C (150°F). The temperature settings are too high and should be reset to 48.9°C (120°F). The 4.5 kW electric heater should be set at 43.3°C (110°F) from the present 60.0°C (140°F) setting and the 386 litre (85 gallon) gas heater should be set at 43.3°C (110°F) from the present 65.6°C (150°F) setting.

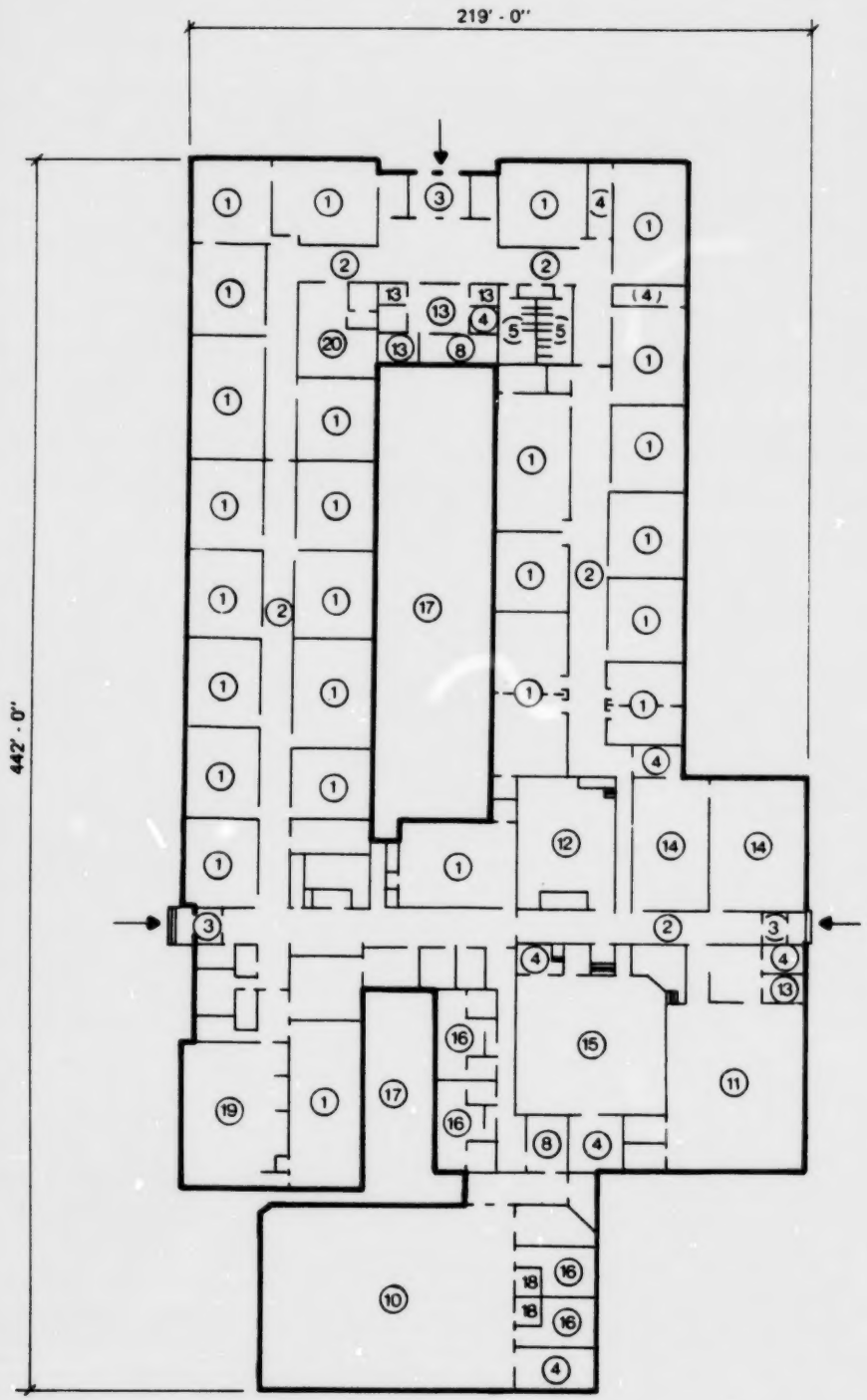
4. Unit Ventilators - It was observed that the dampers were not operating properly and that the steam valve was also inoperative for one of the unit ventilators. This inefficiency was to be remedied by having all of the unit ventilators checked and repaired if not operating properly. A cost per unit is shown in the table since the nineteen unit ventilators needed varied amounts of repair.

5. Old School Ventilation System Control - It was observed that the damper system was inoperative. Immediate servicing was recommended.

6. Old School Ventilation System Outside Air Reset - It was recommended that the observed mixed air controller be replaced with a mixed air controller complete with outside air reset to allow adjustment of the mixed air set point according to outside air conditions.

9. Demand Control - Since the electrical service at Neelin is on demand rate it was recommended that demand control be implemented. The controller should shed designated loads on a priority basis to minimize the overall facility demands. Scheduled loads include general exhaust fans, hot water heaters and the condensing unit. In addition, the controller should provide scheduling for all the connected loads to ensure that this equipment is off when the school is unoccupied. The savings calculation includes those fuel costs associated with exhausted air in additon to the electrical costs.

10. Gym Incandescent Lights - The gym incandescent lights act only as a standby to the mercury lights. It was recommended that the control circuit for these fixures be augmented with a timer control. This should act to shut these lights off after the mercury lighting has come up to adequate brightness.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. GYMNASIUM
11. LIBRARY
12. LECTURE THEATRE
13. OFFICE
14. SHOPS
15. MUSIC ROOM
16. CHANGE ROOM
17. COURT YARD
18. INSTRUCTOR
19. HOME ECONOMICS
20. ART ROOM

AREA = 68850 ft^2 (6399 m^2)

0 10 20 40
SCALE

ENERSCHOOL PROGRAM
NEELIN HIGH SCHOOL, BRANDON

FIGURE 13

TABLE 30
NEELIN HIGH SCHOOL, BRANDON
BRANDON SCHOOL DIVISION NO. 40

RECOMMENDED RETROFIT OPTIONS
(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Hot Water Temp.	65.6°C	43.3°C - 48.9°C	Reduce Temperature by 16.7°C - 22.3°C	0	37,000	515	0
*2.	Gym Inc. Light Fixture	500W	200W	Reduce Lamp size to 200W	15	3,276	108	0.1
*3.	Gym Relief Damper	Inoperative Motor	as per System Requirement	Replace Damper Motor and Set up with System	650	377,100	5,200	0.1
*4.	Unit Ventilator	Inoperative Damper or Steam Valve	Replace	Service Unit Ventilators to Restore to Normal Operation (19 units)	200/unit	43,500	600/unit	0.3
*5.	Old School Vent. System Control	Controls & Dampers Inoperative	Repair	Service Vent. Unit Control System to Restore Controlled Operation	1,700	325,500	4,500	0.4
*6.	Old School Vent. System Outside Air Reset	Single Set Point M.A. Control	M.A. Control c/w Outside Air Reset	Replace Mixed Air Controller with Outside Air Reset Model	850	86,700	1,200	0.7
*7.	MPR Vent. System	Continuous Operation	Night Set Back	Provide Night Set Back Thermostat and Timer Clock	275	19,200	265	1.0
*8.	Gym Vent. System	Continuous Operation	Night Set Back	Provide Night Set Back Thermostat and Timer Clock	675	45,000	620	1.1
*9.	Demand Control	No Control	Limit Max. Demand Implement Scheduling of Loads	Control Operation of Fan Units, Exh. Fans and Hot Water Heaters	12,000	(24 kVA Average) 188,000	4,100	2.9
*10.	Gym Inc. Lights	No Control	Timer Control	Wire Time Delay to Shut off Inc. Lights After Merc. Fixtures are on	260	2,180	75	3.5
	Total Estimated Implementation Cost				$20,225			
	Total Cost Saving				27,983			
	Payback				1.0 years			
	Capital Budget	6,399 m^2 x $3.55/$m^2$			22,720			

* RECOMMENDED RETROFITS

TABLE 31

NEELIN HIGH SCHOOL
BRANDON
BRANDON SCHOOL DIVISION NO. 40

RECOMMENDED RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Corridor Inc. Lights	Inefficient Light Source	Use more Efficient Source	Replace Inc. Fixtures with 2 Lamp Fluorescent Fixtures	4,200	23,751 + 8.7 kVA Demand	790	5.3
2.	Windows	Excessive Area	Reduce Area	Blank Off Part of Window Area				
				Method #1				
				- Window remains blank off interior to match	9,000	105,000	1,450	6.2
				Method #2				
				- Remove window and blank off to match ext. and interior	20,100	105,000	1,450	13.9
3.	Crawlspace	No Insulation	Insulate	Add exterior rigid insulation and regrade	12,000	32,600	450	26.7

Total Estimated Implementation Cost		$24,425
Total Cost Saving		28,773
Payback		0.85 years
Capital Budget	6,339 m^2 x $3.55/$m^2$	22,725

* RECOMMENDED RETROFIT

ROSEAU VALLEY COLLEGIATE

ROSEAU VALLEY COLLEGIATE - Dominion City

Building Description

Roseau Valley Collegiate, the second largest of the rural schools, was constructed in 1971. The school is composed of a multipurpose area, gym complete with change facilities, elementary teaching area, staff and office areas, material resource centre, classrooms, laboratory facilities, commercial, home economics, mechanical room and shops.

The total school area is 4,252 square metres with an exterior perimeter of 317 metres.

The building is a single level structure with crawl space under the entire building.

Wall construction consists on the exterior of 101.6 mm (4") splitface limestone, air space, 38.1 mm (1 1/2") of rigid insulation, vapour barrier and concrete block (RSI 1.4/R8).

The roof is a built-up assembly with 38.1 mm (1 1/2") of rigid insulation, vapour barrier and 38.1 mm (1 1/2") steel deck on steel joists (RSI 1.1/R6).

The crawl space has a continuous 25.4 mm (1") rigid insulation layer on the interior.

The windows are all double glazed construction.

It should be noted that the RSI/R values indicated are based on the combined insulation value of the limestone face, insulation, air space and concrete block.

The school mechanical system consists of centralized fan systems utilizing roof top units. Three of the units provide ventilating only (U1, U2 and U3), while two of the units have gas fired heating systems as well as providing ventilation (U4 and U5). Each roof top unit, except the gym unit, has a cooling coil and a companion roof top condensing unit. Hot water reheat coils provide individual space temperature control by reheating the central system air supply.

The perimeter of the building is equipped with steam radiation with individual room thermostat control and miscellaneous areas of the school are provided with individual unit heaters (foyers, storage, etc.).

Steam heating is provided by two gas fired boilers rated at 686.8 kW (2,345,000 BTU/hr). Hot water supply for heating coils is provided by a steam to hot water converter.

The electrical service consists of a single 120/208V, 3 phase, 4 wire, 1600A service, fed via a main distribution panel and subdistribution panel with connections to individual light panels throughout the building for power distribution.

Lighting, except for the gym, is provided by 2 and 4 lamp fluorescent fixtures. The gym area utilizes 400 W mercury vapour fixtures.

Energy Consumption

Annual energy consumption as as follows:

Natural Gas	1,276,425 kWh
Electricity	329,400 kWh
Total Annual Consumption	1,605,825 kWh
Energy Index	378 kWh/m^2/a

Retrofit Measures

The total capital budget identified for Roseau Valley Collegiate is $15,100.00 compared to an estimated total value for recommended retrofit items of $16,370.00. The retrofit options selected by the school with a payback period less than or equal to five years and priced within the capital budget are items 1, 3, 4, 5, 15 and 16. The school also chose to go beyond the scope of the recommended retrofits by replacing the doors in the shop room, gym and multi-purpose room including retrofit item 6 which specified that the doors be weatherstripped. The following is a description of the selected retrofit items listed in Tables 32 and 33.

1. It was found that the air handling units ran continuously. To reduce operating costs, a recommendation was made to operate the units on an occupied/unoccupied cycle with a temperature override. This is covered in item 15, however, in addition to this, during the unoccupied cycle when the unit is required to run because of temperature, the mixed air controller should be disabled to reduce heating load. This should be done through the time clocks used in item 15 and an auxiliary relay.

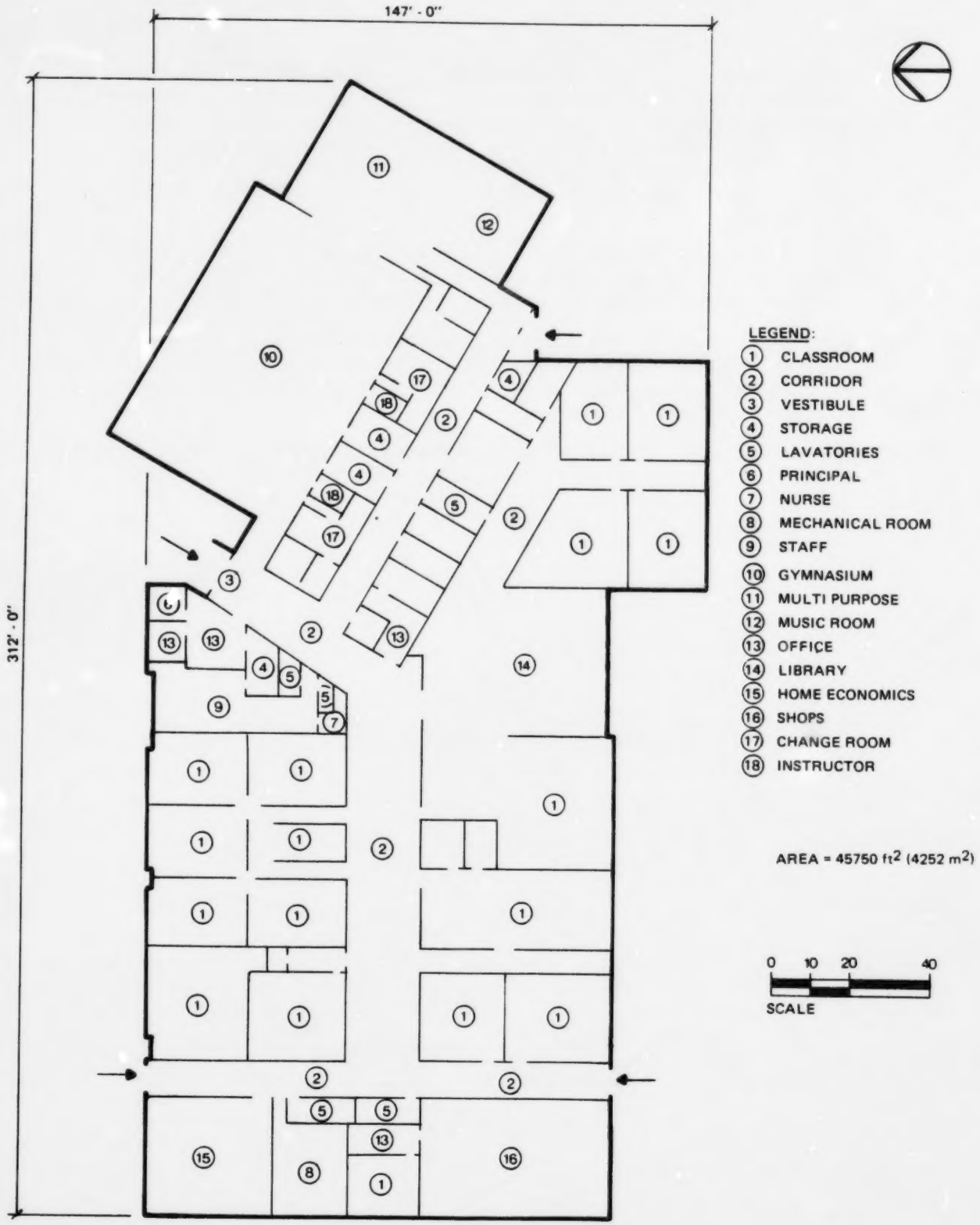
3. Air Handling Unit Dampers - Each unit had dampered duct inlets through the roof which required sealing to eliminate heat losses. The estimated cost was calculated on a three year life cycle as shown in Table 32.

4. Gym Air Handling Unit - These units operated manually during use period and when outside temperature was below -10°C. It was recommended that the units be equipped with a manual reset timer in order to reduce occupied use periods. Also the installation of a mixed air control override to shut off outside air during times of no occupancy when the unit has to run increases energy savings.

5. Exhaust Fans F6, F7 and F16 - These fans were controlled by an on/off switch. The installation of a manual reset timer decreases run time and thus reduces the loss of exhausted air.

15. Air Handling Units - The air handling units were running 24 hours per day. Considerable savings occur when the scheduling of the units on an occupied/unoccupied cycle with an outside temperature override to maintain the space.

16. Gym Incandescent Lights - Since these gym lights act only as standby to the mercury lights, the control circuit for these fixtures should have been augmented with a timer control. This control acts to shut these lights off after the mercury lighting has come up to adequate brightness.



ENERSCHOOL PROGRAM
ROSEAU VALLEY COLLEGIATE, DOMINION CITY

FIGURE 14

TABLE 32

ROSEAU VALLEY COLLEGIATE
DOMINION CITY
BOUNDARY SCHOOL DIVISION NO. 16

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Air Handling Units Mixed Air	Continuous Operation	Override During Unoccupied Cycle	Disable M.A. Control During Unoccupied Cycle via Time Clock	650	370,700	5,280	0.1
*2.	Gym Inc. Light Fixture	500 W	200W	Reduce Lamp Size to 200W	15	2,520	99	0.2
*3.	Air Handling Unit Damper	Leaking	Seal	Weather Edge all Dampers Around Units	85 (annualized)	16,250	230	0.4
*4.	Gym Air Handling Unit	Continuous Operation Manual Ctl.	Timed Ctl. with M.A. Override	Operate unit via Manual Reset Timer and Disable Mixed Air Ctl. when Outside Temperature below -10°C	850	146,000	2,070	0.4
*5.	Exhaust Fans F6, F7, & F16	Manual Control	Timed Control	Provide units with Manual Reset Timers	700	109,500	1,550	0.5
*6.	Doors	Unsealed	Seal	Weatherstrip Doors	400	56,500	800	0.5
*7.	Staff Rm. Lights	150W/Fixt.	60W/Fixt.	Replace all Bulbs with 60W size	60	2,500	97	0.6
*8.	Library Lights	1076 Lux	753 Lux	Disconnect 8 Fluorescent Fixtures	100	1,600	125	0.8

* RECOMMENDED RETROFITS

TABLE 32 (Continued)

ROSEAU VALLEY COLLEGIATE
DOMINION CITY
BOUNDARY SCHOOL DIVISION NO. 16

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*9.	Classroom B.41 Lights	1076 Lux	753 Lux	Disconnect 22 Fluorescent Fixtures	200	4,400	172	1.2
*10.	Corridor Lights	538 Lux	215 Lux	Disconnect 35 Fluorescent Fixtures	400	7,350	290	1.4
*11.	Classroom A15 Lights	1023 Lux	70FC	Disconnect 9 Fluorescent fixtures	100	1,800	72	1.4
*12.	Multi Purpose Room Lights (Inc.)	150W	75W	Replace Bulbs with 75W Size	85	475	55	1.6
*13.	Classroom A05, A06, A07 and A13 Lights	1023 Lux	753 Lux	Disconnect 36 Fluorescent Fixtures	450	7,200	290	1.6
*14.	Classroom A08 & A11 Lights	1023 Lux	753 Lux	Disconnect 8 Fluorescent Fixtures	100	1,600	63	1.6
*15.	Air Handling Units	Continuous Operation	Occupied/ Unoccupied Operation	Set Up Units on Time Clock with Temperature Override	2,500	55,400	725	3.4
*16.	Gym Inc. Lights	No Control	Timer Control	Wire Time Delay to Shut Off Inc. Lights after Merc. Fixtures are on	275	1,680	65	4.2

* RECOMMENDED RETROFITS

Total Estimated Implementation Cost		$16,370
Total Cost Saving		11,983
Payback		1.4 years
Capital Budget	4,252 m^2 x $3.55/$m^2$	15,100

TABLE 33

ROSEAU VALLEY COLLEGIATE
DOMINION CITY
BOUNDARY SCHOOL DIVISION NO. 16

RECOMMENDED RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Demand Ctl.	No Control	Limit Max. Demand & Schedule Loads	Control Operation of Air Handling Units, Exhaust Fan and Parking Plugs	5,400	15 kVA (average)	800.00	6.75
*2.	Crawl Space	Wet	Regrade	Regrade and Sod Around School To Prevent Moisture Entry Into Crawl Space	4,000			
3.	Gym Merc.	End of Life	Replace Bulbs	Bulbs are Approaching End of Life Span. Replace as Part of Normal Maintenance	See Description			

* RECOMMENDED RETROFITS

Total Estimated Implementation Cost	$25,770
Total Cost Saving	12,783
Payback	2.0 years
Capital Budget 4,252 m^2 x $3.55/$m^2$	15,100

ST. JOACHIM COLLEGIATE

ST. JOACHIM SCHOOL, LaBroquerie

Building Description

St. Joachim School was constructed in two phases. The initial construction occurred in 1960 and consists of 8 classrooms, a multi-purpose room, washrooms and associated teacher areas. A gymnasium addition was built in 1970.

The total school area is 1,887 square metres with an exterior perimeter of 236 metres.

The building is a single level structure with a crawl space under the older section and the newer change areas.

The wall construction of the old school consists mainly of 101.6 mm (4") face brick veneer, an air gap 25.4 mm (1") rigid insulation, and 508.0 mm (20") concrete block (RSI 0.4/R4). The gymnasium addition has a similar wall construction but with 38.1 mm (1 1/2") rigid insulation (RSI 1.1/R6).

The roofing on the old school is a built-up roof with 38.1 mm (1 1/2") rigid insulation on steel decking (RSI 0.4/R4). The gymnasium has similar construction with 25.4 mm (1") aerofoam insulation (RSI 1.1/R6).

The grade beams in the crawl space are insulated with either 25.4 mm (1") (old school) or 50.8 mm (2") (gymnasium and change areas) rigid insulation.

The windows are double glazed.

It should be noted that the RSI/R values indicated are based on the combined insulation value of the entire assembly.

The school's mechanical system consists of a central oil fired hot water boiler which feeds baseboard radiation, convectors, force flows, and hot water coils in the main school. A separate pumped circuit feeds unit ventilators in the gymnasium addition. A central air handling unit provides ventilation to the main school areas. It should be noted that the air handling unit was originally designed to take 100% make-up air. It has been modified to operate on virtually 100% return air.

Domestic hot water is provided by a 454.6 litre (100 imperial gallon) tank with 2-3,000W electric immersion heaters. The system is equipped with a domestic hot water recirculating system.

The electric service is rated at 115/230V, 10, 3W 400A and power is metered through two existing meters. The power is charged at the General Service Rate.

The lighting in the old school is mostly fluorescent in the classrooms and incandescent in the hallways and mechanical rooms. The lighting in the gymnasium addition utilizes incandescent fixtures.

The lighting is predominantly fluorescent inside the classroom and hallways. The exterior lighting is predominantly incandescent and the gymnasium is lit with mercury vapour fixtures.

Energy Consumption

Annual energy consumption was as follows:

Oil	475,020 kWh
Electricity	222,650 kWh
Total Annual Consumption	697,670 kWh
Energy Index	370 kWh/m^2/a

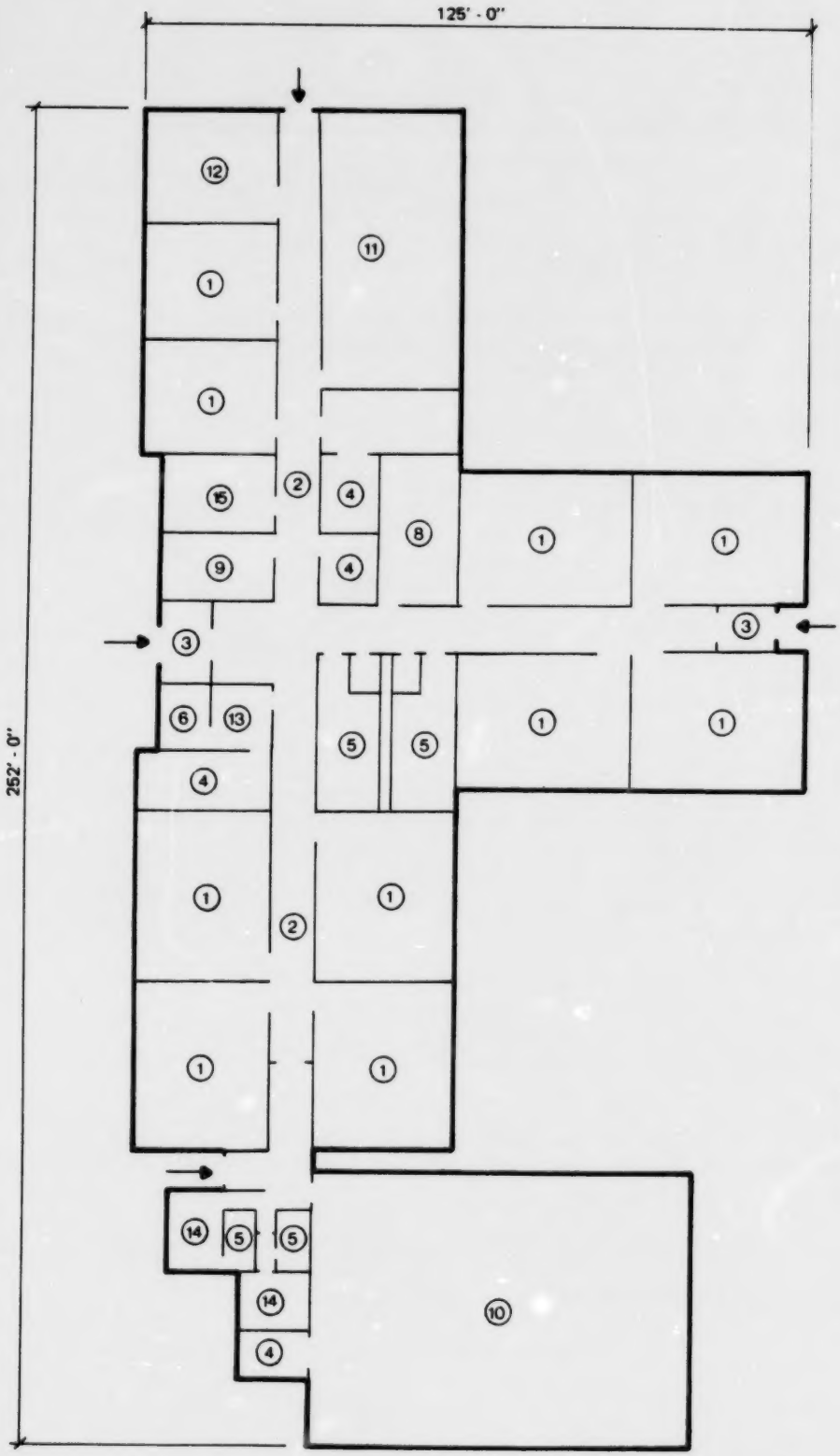
Retrofit Measures

The total capital budget identified for St. Joachim School is $6,699.00 compared to an estimated total value for recommended retrofit items of $5,270.00. The retrofit options selected by the school with a payback period of five years or less and priced within the capital budget are items 1, 4 and 6. The following is a description of the selected retrofit items listed in Tables 34 and 35.

1. Hot Water Tanks - The domestic hot water temperature was set at 60°C (140°F). It was recommended that this temperature be reset to 43°C (110°F) to affect the savings indicated in Table 34. The resulting hot water quality is not affected by the reduced temperature setting.

4. It was recommended that the weatherstripping on the entrance doors be changed to a more efficient variety that provides a better wind seal.

6. The installation of a high setback system which automatically drops the set points of the thermostats in the classrooms by 2.8°C (5°F) during unoccupied hours was recommended.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. GYMNASIUM
11. LIBRARY
12. MUSIC
13. OFFICE
14. CHANGE ROOM
15. KITCHEN

AREA = 20300 ft^2 (1887 m^2)

0 10 20 40

SCALE

ENERSCHOOL PROGRAM
ST. JOACHIM SCHOOL, LA BROQUERIE

FIGURE 15

TABLE 34

ST. JOACHIM SCHOOL
LA BROQUERIE
SEINE RIVER SCHOOL DIVISION NO. 14

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Reset Domestic Hot Water Temperature	60°C	43.3°C		0	1,161	40	0.
*2.	Reduce Lighting in Corridors	1023 Lux	753 Lux	Turn Off One Half of the Fixtures in the Hallway by Putting "Locking Dogs" on Breaker Panel	20	2,467	85	0.3
*3.	Remove Hot Water Heater From Flat Rate	Flat Rate	General Service Rate	Advise Manitoba Hydro that You Wish to Eliminate Flat Rate on the 6 kW of Domestic Hot Water Heating	100	0	290	0.4
*4.	Improve Door Weatherstrip (Poor Seal)	Nap Type (Poor Seal)	Vinyl Type (Good Seal)	Change Type of Weatherstripping to More Efficient Style	200	8,412	214	0.7
*5.	Reduce Lighting in Classrooms	969 Lux	753 Lux	Remove Centre Fixture in Back Two Rows of Each Classroom	200	3,483	120	1.7
*6.	Night Setback	None	Drop Space Temp. 2.8°C for Unoccupied Time	Install a 2.8°C Night and Weekend Setback System	4,750	39,074	994	4.8

* RECOMMENDED RETROFITS

Total Estimated Implementation Cost		$5,270
Total Cost Saving		1,743
Payback		3.0 years
Capital Budget	1,887 m^2 x $3.55/$m^2$	6,699

TABLE 35

ST. JOACHIM SCHOOL
LA BROQUERIE
SEINE RIVER SCHOOL DIVISION NO. 14

RECOMMENDED RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Add an Electrical Boiler to Supplement Oil Fired Boiler	Totally Fuel Oil	65% Electric 35% Fuel Oil	Add a 50 kW Electric Boiler and Upgrade Service	22,000	0	$2,500	8.8
2.	Improve Drainage Around Building to Keep Crawl-space Dry	Poor Drain-age and Insulation	Improve In-sulation and Drainage	Re-insulate With Rigid Insulation and Earth Berm the Perimeter. Extend Downspouts. Eliminate Crawlspace Ventilation	9,100	56,803	1,445	6.3

BERENS RIVER SCHOOL

BERENS RIVER SCHOOL, Berens River

Building Description

Berens River School was built in two stages. Phase I was constructed in 1967 and consists of 10 classrooms, an auditorium with stage, washrooms, and teacher areas. Phase II was constructed in 1977 and consists of 5 classrooms, a science laboratory, a gymnasium with changing facilities and showers, a vocational area, and a home economics area. Subsequent renovations converted the original auditorium into classrooms.

The total school area is 3,512 square metres with a total exterior perimeter of 367 metres.

Both phases are single level structures with crawl spaces.

Phase I wall and roof construction consists of 76.2 mm (3") thick cedar planking with 25.4 mm (1") rigid insulation and a 12.7 mm (1/2") drywall interior (RSI 1.1/R6).

Phase II wall construction consists of brick panels, 12.7 mm (1/2") plywood sheathing, 50.8 mm x 152.4 mm (2" x 6") wood studs, RSI 3.5 (R20) batt insulation, 9.5 mm (3/8") plywood sheathing and 12.7 mm (1/2") drywall (RSI 3.5/R20). The roof insulation is rated at RSI 4.9 (R28).

The windows in both phases are double glazed with some windows in Phase I triple glazed.

The crawl space of Phase I was originally insulated with 50.8 mm (2") rigid insulation (RSI 1.4/R8). The support for the skirting enclosing the crawl space appears to have deteriorated, such that the skirting has sagged leaving an open gap for approximately 15% of the perimeter. The crawl space of Phase II is insulated with 76.2 mm (3") rigid insulation (RSI 2.6/R15).

The school's heating system consists of two oil fired hot water heating boilers with a total output capacity of approximately 1.23 mWh (4,200 MBH). One boiler is located in the mechanical room of each building. The boilers supply heating water to perimeter baseboard radiation unit heaters, and heating coils in the three central air handling units. Central fan systems are provided for the classrooms of Phase I, the classrooms of Phase II, and the gymnasium of Phase II. The air handling units of the classrooms feed individual VAV boxes which are sequenced with the baseboard radiation to provide zone control.

The electrical service for both buildings is rated at 120/208V, 3 phase, 4 wire, 800A. The electrical meter is presently on the Full Cost Diesel Rate. Manitoba Hydro is proposing to build a power line into Berens River. When this is completed the rate would drop to the Power Standard Rate.

Energy Consumption

Annual energy consumption was as follows:

Oil	1,438,725 kWh
Electricity	264,250 kWh
Total Annual Consumption	1,702,975
Energy Index	485 kWh/m^2/a.

Retrofit Measures

The total capital budget identified for Berens River School is $12,457.00 compared to an estimated total value for the recommended retrofit items of $18,463.00. The retrofit options selected by the schools are items 1, 2, 3, 4, 6, 7, 9, and 11. The following is a description of the selected retrofit items listed in Table 36.

1. Hot Water Tanks - The tanks were set at 60.0°C (140°F). It was recommended that this temperature be reset to 48.9°C (120°F) to affect the savings indicated in Table 36. The resulting hot water quality is not affected by the reduced temperature setting.

2. It was observed that both classroom air handling units were fitted with minimum position controllers on the outside air dampers as well as outdoor reset control of the air supply temperature. At the time of the audit the outdoor temperature was 5.6°C (42°F). and the supply air was 21.1°C (70°F) in the Phase I unit and 25.6°C (78°F) in the Phase II unit. The temperature should have been 12.2°C (54°F) on both systems which indicates improper operation of the reset schedule. The purpose of the system is to heat with the baseboard radiation and cool and ventilate with the air make-up. Overheating the ventilation air imbalances the systems and causes overheating and energy wastage.

   Also noted was the fact the minimum position outside air controller was being adjusted too high. A minimum setting of 10% fresh air will cost $5,668.00 a year in fuel oil. Increasing this to 15% would cost an additional $2,834.00. It was recommended that the minimum position controller be removed and the dampers controlled from the supply air temperature. The savings shown in Table 36 are based on the operation for one day.

3. It was noted that the door weatherstripping was unsatisfactory and should be repaired.

4. The incandescent standby lighting in the gymnasium provided more light than required. It was recommended that the 4 - 500 W lamps be replaced with 200 W lamps.

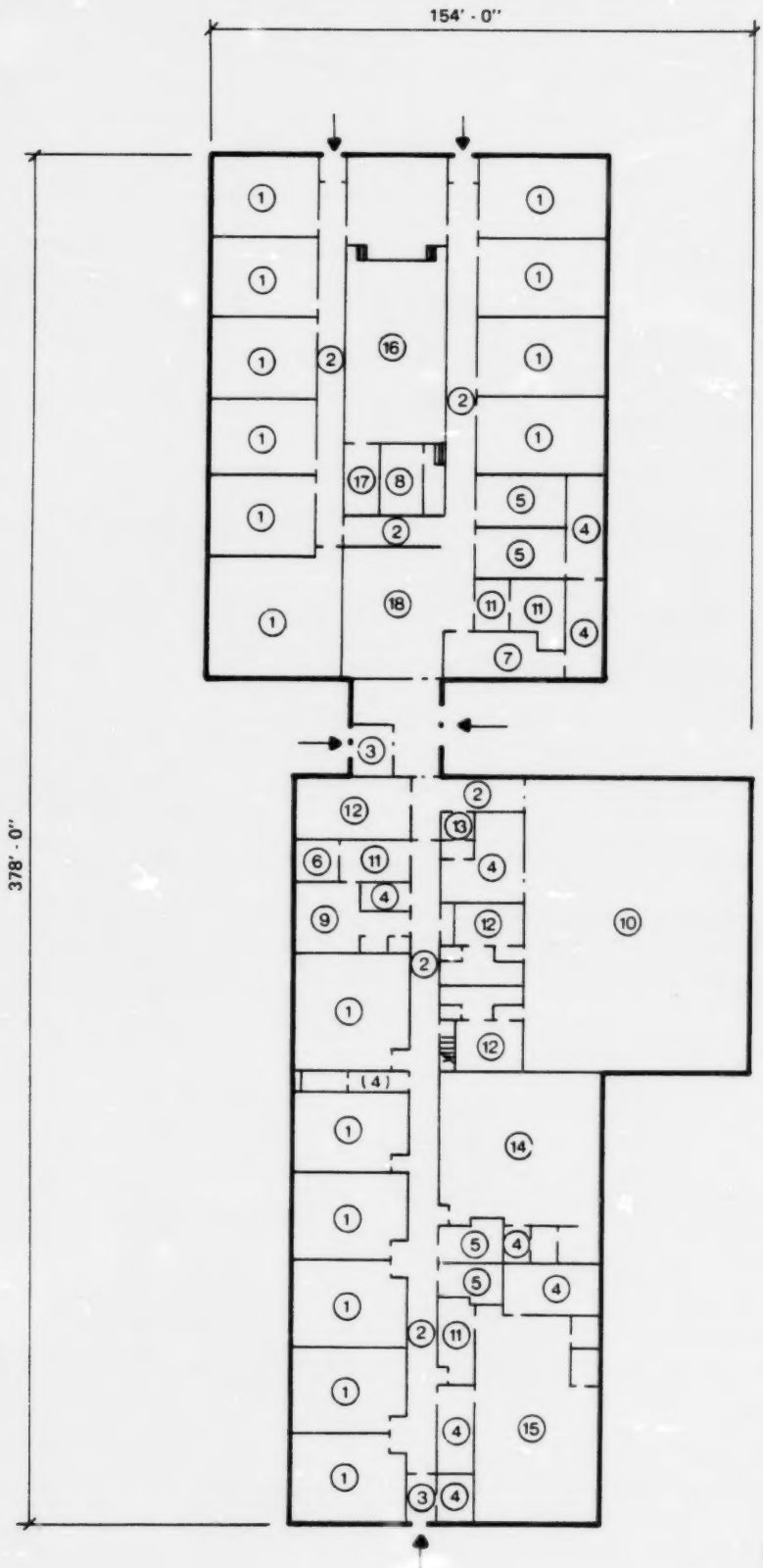
5. Both buildings had their crawl space vented to remove moisture in the winter. Since there is no moisture migration in winter and because these are warm crawl spaces the ventilation is not necessary. It was recommended that the supply ducts be capped off and the relief openings closed.

6. It was observed that the arrangement of the relief air opening in the gymnasium allows outdoor air into the gymnasium when the wind is southerly and the gymnasium fan is not running. Therefore the recommendation was made that 3/4 of the relief opening be closed off.

7. The lighting levels in the classrooms of Phase I were excessive 1,023 lux (95 FC). It was recommended that 4 fixtures per classroom be disconnected to reduce the lighting level to 753 lux (70 FC).

9. The lighting levels in the corridors of Phase II were excessive 431-646 lux (40-60 FC). It was recommended that every second fixture be disconnected to reduce the lighting level to 215 lux (20 FC).

11. The standby incandescent lighting in the gymnasium was found to operate continuously with the main mercury vapour lighting. It was recommended that a photo electric control be installed to shut off the standby incandescent lights when the mercury vapour lights were on.



LEGEND:

1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. GYMNASIUM
11. OFFICE
12. CHANGE ROOM
13. INSTRUCTOR
14. HOME ECONOMICS
15. SHOPS
16. AUDITORIUM
17. ELECTRICAL
18. STUDENT GATHERING AREA

AREA = 37790 ft^2 (3512 m^2)

0 10 20 40
SCALE

ENERSCHOOL PROGRAM
BERENS RIVER SCHOOL, BERENS RIVER

FIGURE 16

TABLE 36

BERENS RIVER SCHOOL
BERENS RIVER
FRONTIER SCHOOL DIVISION NO. 48

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*1.	Hot Water Tanks	60°C	43.3°C	Reduce Temperature by 16°C	-	2,700	100	0
*2.	Repair of Mixed Air Reset Schedule on Classroom A/H Units	Control Inoperative	Repair and Revise Control	Set up Reset Schedule and Remove Minimum Fresh Air Control	300	2,800/day	75.00/day	0
*3.	Doors	Unsealed	Seal	Weatherstrip Doors	108	38,200	1,040	0.1
*4.	Gym Lighting	500W	200W	Replace 500W Gym Standby Lighting Bulbs with 200W	15	2,520	99	0.2
*5.	Eliminate Crawlspace Ventilation	Operative	Delete	Blank-off Ducts. Blank-off Relief Openings	390	60,640	1,651	0.2
*6.	Reduce Gym Air Relief	1.2mx2.4m (4' x 8')	Reduce Size to 1.2mx0.9m 4' x 3'	Seal Off 60% of Opening with Drywall and Studs	250	18,932	516	0.5
*7.	Reduce Classroom Lighting in Phase I	1023 Lux	753 Lux	Delete 4 Fixtures/Class	700	7,182	280	2.5
*8.	Delete Skylights in Phase I Corridor and Repair Roof		Delete	Seal Off Skylights With a New Ceiling Flush with Existing	8,500	112,417	3,064	2.8

TABLE 36 (Continued)

BERENS RIVER SCHOOL
BERENS RIVER
FRONTIER SCHOOL DIVISION NO. 48

RECOMMENDED RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

	ITEM	CONDITIONS EXISTING	CONDITIONS REVISED	DESCRIPTION	IMPLEMENTATION COST ($/a)	ENERGY SAVED (kWH/a)	COST SAVING COST ($/a)	AVERAGE PAYBACK PERIOD (YEARS)
*9.	Reduce Lighting in Corridor of Phase II	431-646 Lux	215 Lux	Delete 9 Fixtures	200	1,806	70	2.9
10.	Add Night Setback System	None	Install Temperature Setback	Reset Temperature 5°F During Unoccupied Hours	9,800	103,904	2,832	3.5
11.	Gym Lighting	Continuous Operation	Timed Operation	Add a Timer to Standby Lighting	275	1,680	66	4.2
*12.	Install a Berm Around Perimeter of Phase II	Poor Drainage and Seal	Improve Drainage and Seal	Install an Earth Berm and Close Off and Reseal Crawlspace	8,000	73,378	2,000	4.0
13.	Replace 1 Oil Fired Boiler With Electric	Totally Oil Fired	Partially Electric Heat	Replace Oil Fired Steam Boiler with Electfric	40,500	0	5,133	7.9

* RECOMMENDED RETROFITS

Total Estimated Implementation Cost		18,463
Total Cost Saving		8,820
Average Payback		2.1 years
Capital Budget	3,512 m^2 x $3.55/$m^2$	12,467

NORTHERN SCHOOLS

LEAF RAPIDS EDUCATION CENTRE

LEAF RAPIDS EDUCATION CENTRE

Building Description

The Leaf Rapids Education Centre, which forms part of the Leaf Rapids Town Centre Complex, was constructed in 1973, with a major 2 - level classroom section addition in 1982. The school is heated electrically. Water and sewer is provided by the town.

Electrical Consumption and Cost

Electrical consumption and cost for the year ended September, 1983 is presented herein.

Of the total electrical bill of $56,905 for the period shown, $32,663 is demand charges. This is approximately 57% of the total bill.

From these component figures it is apparent that to reduce the total annual Hydro bill for the school, it is necessary to limit the peak demand as well as reduce the consumption.

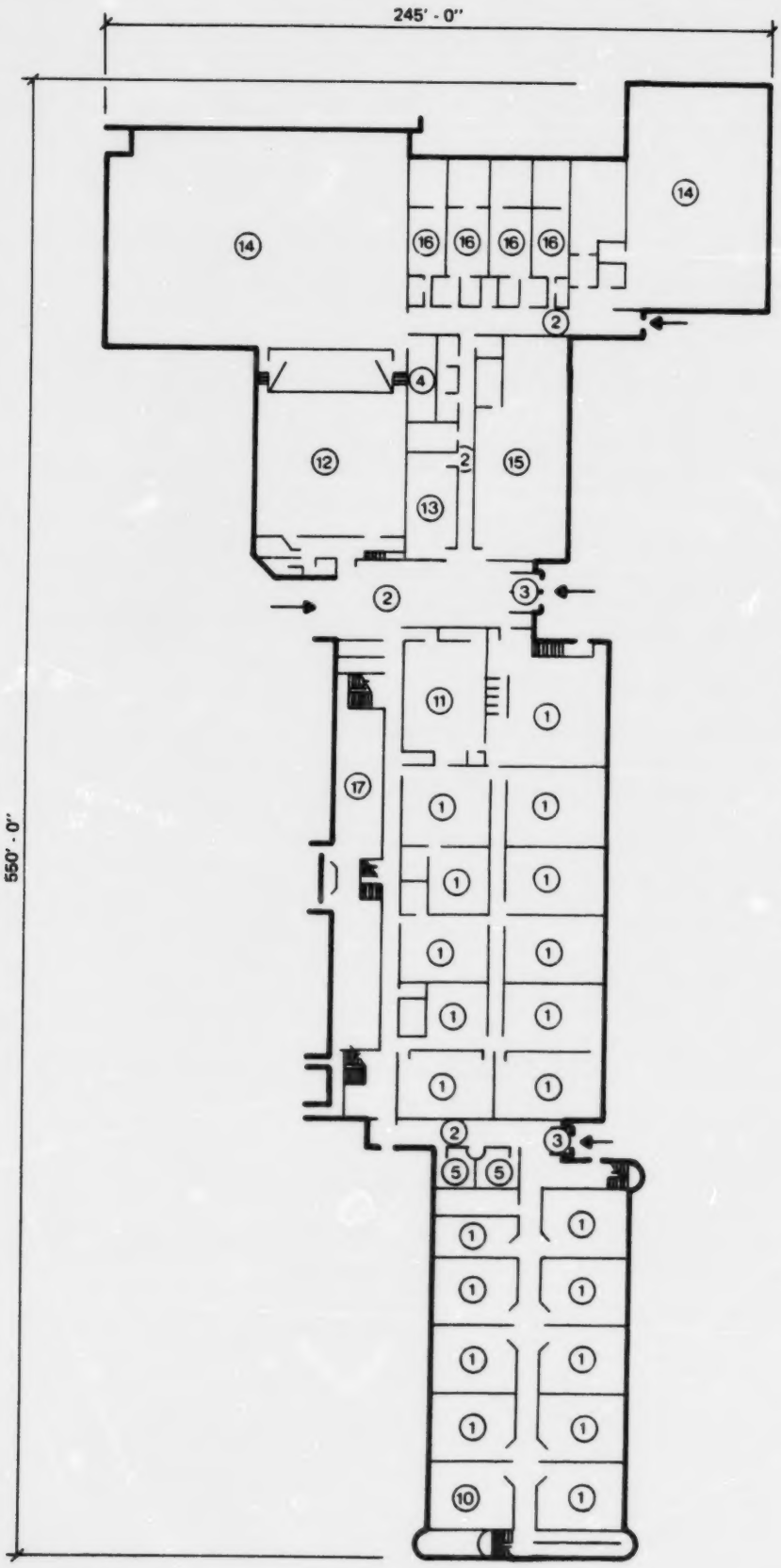
Note that the school addition was opened in September, 1982, and as a result the figures shown for electrical consumption and demand represent a full year's occupancy of the entire school.

Details of the selected retrofit options are shown in Tables 37 and 38.

Energy Consumption

Annual energy consumption was as follows:

Oil	n/a
Electricity	1,879,200 kWh
Total	1,879,200
Energy Index	257 kWh/m^2/a



MAIN FLOOR PLAN

LEGEND:

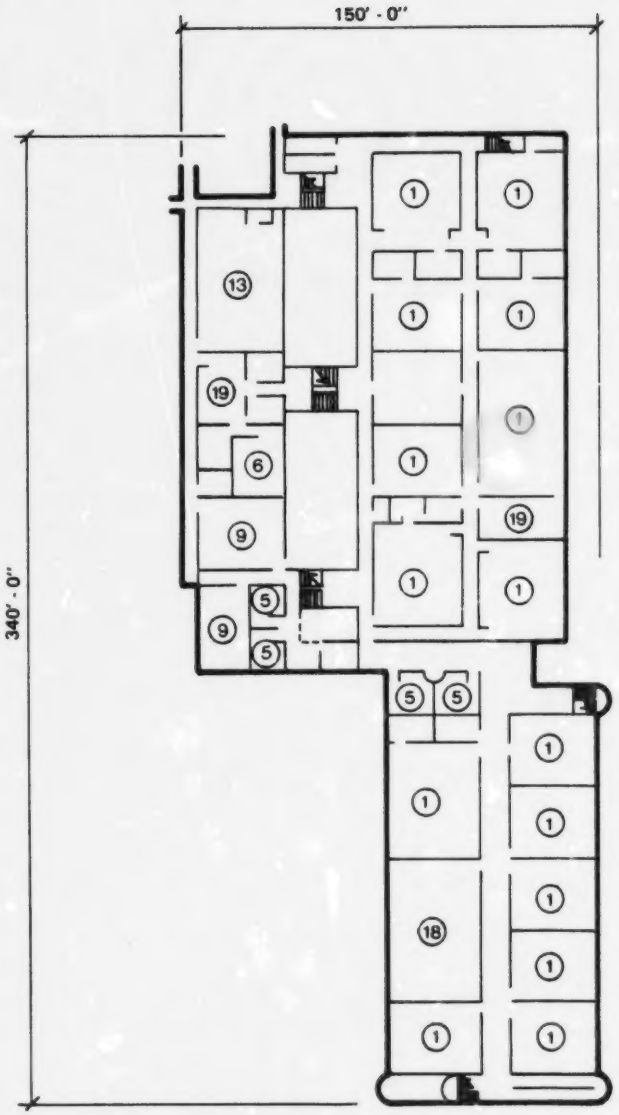
1. CLASSROOM
2. CORRIDOR
3. VESTIBULE
4. STORAGE
5. LAVATORIES
6. PRINCIPAL
7. NURSE
8. MECHANICAL ROOM
9. STAFF
10. RESOURCE
11. ART ROOM
12. THEATRE
13. MULTI PURPOSE
14. GYMNASIUM
15. INDUSTRIAL ARTS
16. CHANGE ROOM
17. LIBRARY
18. HOME ECONOMICS
19. OFFICE

AREA = 78759 ft^2 (7319 m^2)

0 10 20 40 60
SCALE

ENERSCHOOL PROGRAM
LEAF RAPIDS EDUCATION CENTRE,
LEAF RAPIDS

FIGURE 17a



0 10 20 40 60

SCALE

2ND FLOOR PLAN

ENERSCHOOL PROGRAM
LEAF RAPIDS EDUCATION CENTRE,
LEAF RAPIDS

FIGURE 17b

TABLE 37

LEAF RAPIDS EDUCATION CENTRE

SUMMARY OF RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.3.2	Thermostat setting guideline			1.0
5.3.5	Schedule for switching exhaust fans			1.0
5.3.6	Setting of thermostats at programmable controller			1.0
5.3.8	Operation of programmable controller			1.0
5.3.10	Switch off electric heat above 15.6°C (60°F)			1.0
5.3.11	Adjust time settings			1.0
5.4.1	Maintenance equipment			1.0
5.4.3.	Switch off lighting when not required			1.0
5.4.4.	Eliminate perimeter lighting - Level A classrooms			1.0
5.4.7	Power factor correction survey			1.0
5.4.9	Consider painting gym walls lighter colour			1.0
5.3.4.	Interlock washroom exhaust fans with time clocks	1,200	1,360	0.9
5.2	Weatherstripping allocations	500	500	1.0
5.3.7	Set programmable controller	250	250	1.0
5.3.9	Adjust outside air - VAV system	350	350	1.0
5.4.6	Reduce lighting - new section corridors	900	480	1.8
5.3.12	Install manual reset timer - gym	500	220	2.3
5.4.8	Demand control system	15,000	4,500	3.3
5.4.10	Separate switch for locker area	200	50	4.0
5.4.11	Reduce lighting - duplicating room and principal's room	400	100	4.0
5.3.13	Check fresh air dampers and add sealing strips, etc.	2,000	400	5.0

TABLE 38

LEAF RAPIDS EDUCATION CENTRE

SUMMARY OF RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.3.1	Install representative thermostats - original section	1,800	350	5.1
5.3.14	Reduce air quantities	4,800	700	6.2
5.4.5	Modify corridor lighting - level B of original school	10,000	830	12.1
5.3.15	Calibrate temperature gauges	900		?

RUTH BETTS SCHOOL

RUTH BETTS SCHOOL

Building Description

Ruth Betts School was originally constructed in 1963 and named Terrace School. In 1977, a major single level addition joined the original Terrace School to the existing Hudson School to form a school with a total floor area of 5,169 square metres. The school is heated by a combination of electricity and a propane/oil boiler. The classroom section of the Ruth Betts addition is air conditioned. Sewer and water is provided by the Town.

Fuel Oil Consumption and Cost

Quantities of fuel delivered and costs for the year 1980 are presented herein. Approximate total cost of 55,419 litres (12,191 imperial gallons) was $15,117.

Propane Consumption and Cost

For the year 1980 the cost for propane at the school was $751.23, with an estimated consumption of 1,063,550 litres (37,560 cubic feet).

Electrical Consumption and Cost

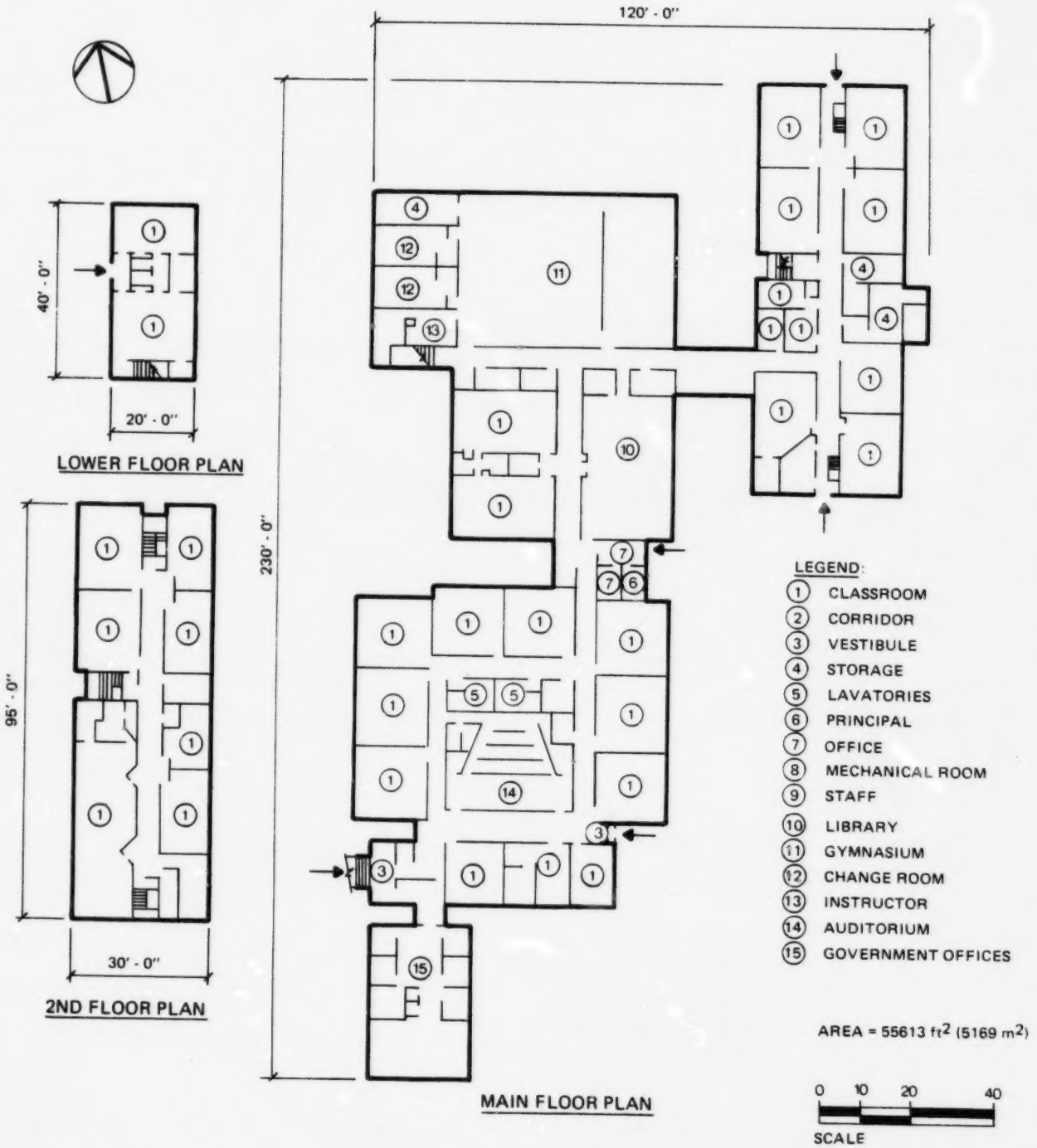
Electrical consumption and cost for the year 1981 are presented at the end of this section.

Details of the selected retrofit options are listed in Tables 39 and 40.

Energy Consumption

Annual energy consumption was as follows:

Oil	583,138 kWh
Propane	27,494 kWh
Electricity	743,040 kWh
Total Annual Consumption	1,353,672 kWh
Energy Index	262 kWh/m^2/a



ENERSCHOOL PROGRAM
RUTH BETTS SCHOOL, FLIN FLON

FIGURE 18

TABLE 39

RUTH BETTS SCHOOL

SUMMARY OF RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.3.2	Thermostat setting guideline			1.0
5.3.6	Switchoff electric heat above 15.6°C (60°F)			1.0
5.3.7	Set cooling stat at 25.6°C (78°F)			1.0
5.3.8	Reset time clocks - original Ruth Betts School			1.0
5.3.13	Thermostat setting-vestibule heaters			1.0
5.3.14	Exhaust fan switching schedule			1.0
5.3.15	Ceiling fan operating guidelines			1.0
5.4.1	Maintenance guidelines			1.0
5.4.3	Switchoff lights when area unoccupied			1.0
5.4.4	Power Factor discussion			1.0
5.4.6	Guideline for ballast replacement			1.0
5.3.3	Install representative stat - F-1	600	310	1.9
5.4.7	Further delamping and ballast disconnections	1,000	340	2.9
5.3.12	Retrofit fresh air dampers	750	250	3.0
5.2.2	Repair and replace weatherstripping	1,100	350	3.1
5.3.9	Tie in W/R exhaust fans to time clocks	1,500	345	4.3
5.3.10	Replace occupied/unoccupied switches adjust mixed air temperature	500	100	5.0
5.3.11	Replace 'normal/override' switch	200	40	5.0

TABLE 40

RUTH BETTS SCHOOL

SUMMARY OF RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.3.4	Install mixed air temperature gauge	500		
5.3.1	Install controls to cycle gym fan in unoccupied periods	2,000	280	7.1
5.3.5	New time clock for F-1/2 dampers	1,500	200	7.5
5.4.5	Load survey and engineering study	6,000		
5.2.1	Increase insulation levels when roof replacement necessary			
5.2.3	Retrofit to entrance/glazed section	7,500	675	11.1

BROCHET SCHOOL

BROCHET SCHOOL

Building Description

Brochet School was constructed in 1968, with a major addition in 1974. The school is heated with a number of oil fired furnaces, electricity is provided by diesel generation, and sewer and water systems are provided on site.

Fuel Oil Consumption and Cost

The approximate annual light fuel oil consumption for the school as estimated by fuel delivered between August, 1982 and March, 1983 was $44,420.75. Delivery costs included in this figure amount to $11,605.80.

With a measured floor area of 2,287 square metres, the annual heating cost per square metre is:

$$\frac{\$44,420.75}{2,287} = \$19.42/m^2$$

Electrical Consumption and Cost

There are two items worth noting:

- There is a substantial billing for electricity during the normally unoccupied summer period.

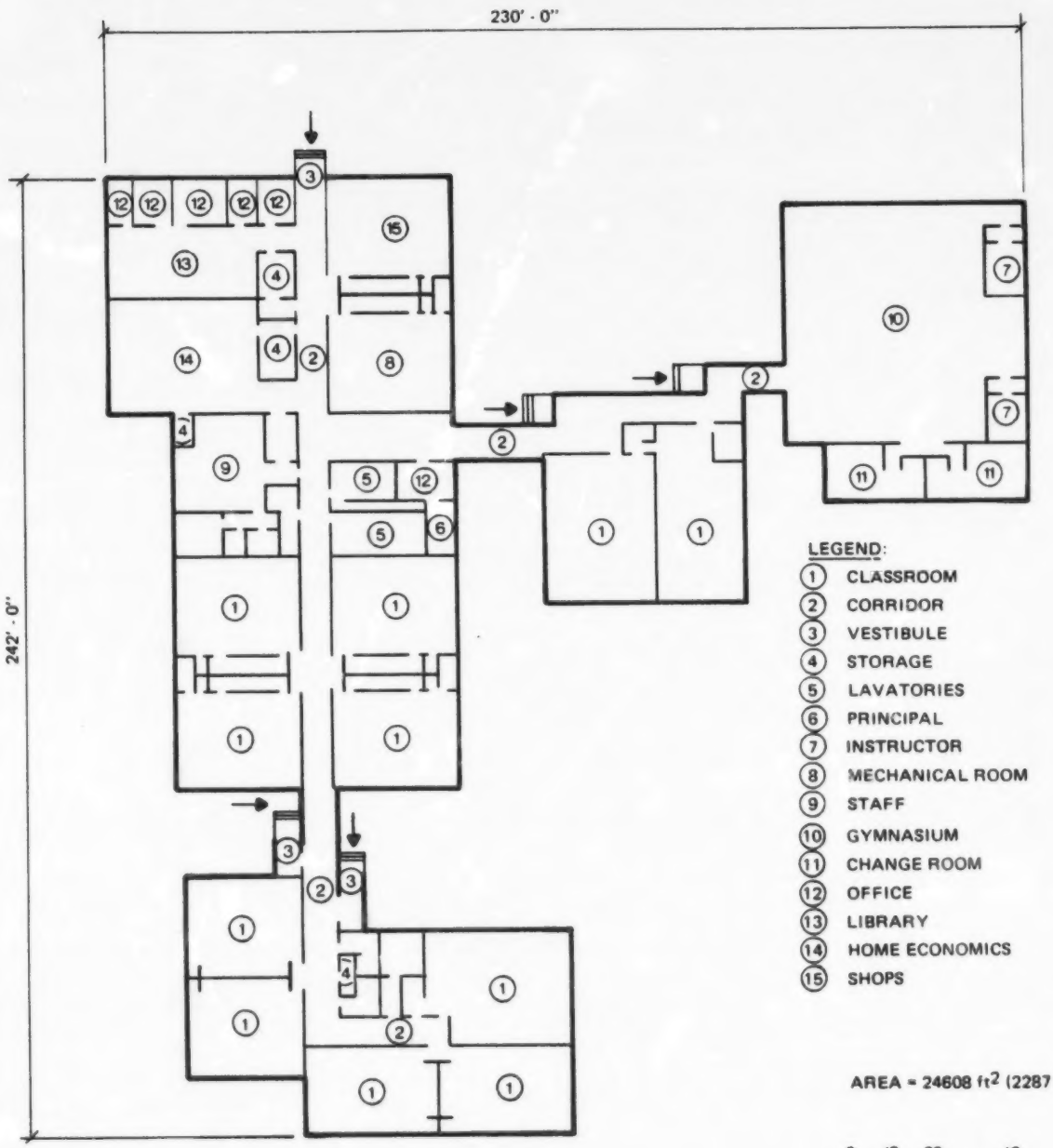
- The average cost of electricity in Brochet for the indicated year was 34.7¢/kWh, about 10 times the average price in Winnipeg. It is obvious from the electrical billing that any attempt at reducing energy costs by switching things off during unoccupied periods or whenever they are not required will result in substantial savings. As an example, operation of one furnace blower for one year costs approximately $1,700.00 - one 100 Watt bulb operating continuously for one year costs approximately $304.00.

Details of the selected retrofit options are listed in Tables 41 and 42.

Energy Consumption

Annual energy consumption was as follows:

Oil	1,163,864 kWh
Electricity	173,700 kWh
Total Annual Consumption	1,337,564 kWh
Energy Index	585 kWh/m²/a



ENERSCHOOL PROGRAM
BROCHET SCHOOL, BROCHET

FIGURE 19

TABLE 41

BROCHET SCHOOL

SUMMARY OF RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.2.7	Ensure that opening type windows are sealed			1.0
5.3.3	Switching of 'day-auto' switches			1.0
5.3.4	Time clock operation			1.0
5.3.10	Reduce domestic hot water temperature			1.0
5.3.11	Space thermostat settings			1.0
5.3.12	Re-instate operation of Library/Home Economics return fan			
5.3.13	Guideline re placing objects on counter top grilles			1.0
5.3.14	Check and replace furnace filters as required			
5.3.15	Blank off 2/3 of air to maintenance shop			
5.3.16	Re-route exhaust from range hood			
5.3.18	Clean and maintain humidifiers			
5.4.3	Turn off lights when not in use			1.0
5.3.1	Modifications to fresh air intake #2	2,600	5,920	0.4
5.3.8	Interconnect exhaust fans to central control	1,000	1,900	0.5
5.3.5	Central control system (time clock)	2,000	up to 2,000	1.0
5.3.20	Furnace maintenance	2,000	2,000	1.0
5.3.7	Replace oil burners	15,000	13,000	1.2
5.3.19	Night set back thermostats	2,500	1,825	1.4
5.4.7	Utilize energy saving lamp ballasts	13,750	6,890	2.0
5.4.5	Revise gym lighting	6,250	2,854	2.2
5.4.6	Revise Home Economics lighting	2,625	1,200	2.2
5.3.6	Gym manual reset timers	600	200	3.0
5.2.2	Repairs and weatherstripping at entrances	1,800	360	5.0
5.2.3	Replace window sections with insulated in-fill panels	3,700	740	5.0

TABLE 42

BROCHET SCHOOL

SUMMARY OF RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.2.7	Vestibules at M-22, M-23	4,000	700	5.7
5.3.17	Downdraft fans	2,700	400	6.8
5.3.2	Control systems repairs	3,000		
5.2.6	Change attic ventilation	7,500		
5.2.1	Insulate ceilings	10,000	900	11.1
5.3.9	Review shop program	1,500		
5.4.1	Check, service and make operable emergency lighting system	2,000		
5.4.2	Check, service and make operable fire alarm system	2,000		
5.4.4	Re-anchor all fluorescent lighting in school addition	2,000		

SCOTT BATEMAN JUNIOR HIGH SCHOOL

SCOTT BATEMAN JUNIOR HIGH SCHOOL

Building Description

Scott Bateman School was constructed in 1972-1974. The school, which has a total floor area of 5,730 square metres, is a wood frame structure. Heating for the building is provided by a large oil fired apparatus throughout the building. Ventilation and air distribution is provided by air handling units (eleven in total) located in ceiling spaces and crawl spaces. Sewer and water is provided by the town of The Pas. Lighting is mostly fluorescent with some incandescent. Electrical receptacles are provided for 28 cars.

Fuel Oil Consumption and Cost

With measured floor area of 5,730 square metres, the annual heating cost per square metre is:

$$\frac{\$25,029.44}{5,730} = \$4.37/m^2$$

Energy consumed for heating the building is calculated to be 934.3 kWh/m^2 year.

Electrical Consumption, Demand and Cost

The annual electrical cost per square metre for 1983 is:

$$\frac{\$17,280.26}{5,730} = \$3.02/m^2$$

Total Energy Consumption

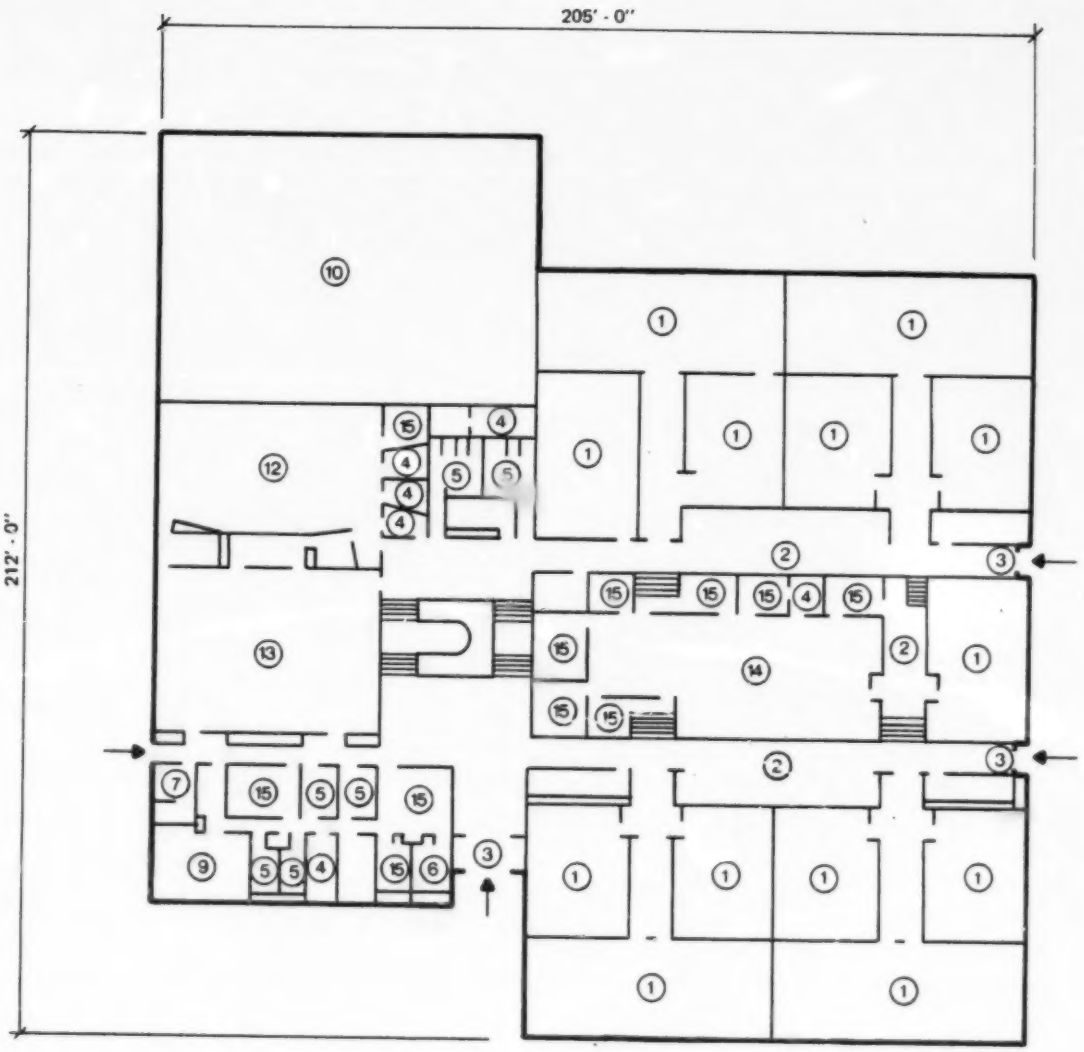
For a total of 37 Winnipeg schools, the total building energy consumption in 1978 ranged from a low of 127.0 kWh/m^2 year to a high of 651.2 kWh/m^2/year, with an average of 371.4 kWh/m^2/year. The total consumption at Scott Bateman of 253.4 kWh/m^2/year represents a relatively energy efficient school, a result of good building construction and good mechanical and electrical system design and operation.

Details of the selected retrofit options are listed in Tables 43 and 44.

Energy Consumption

Annual energy consumption was as follows:

Fuel Oil	936,630 kWh
Electricity	516,480 kWh
Total Annual Consumption	1,453,110 kWh
Energy Index	254 kWh/m^2/a



MAIN FLOOR PLAN

LEGEND:

1	CLASSROOM	11	ELECTRICAL
2	CORRIDOR	12	MUSIC
3	VESTIBULE	13	THEATRE
4	STORAGE	14	LIBRARY
5	LAVATORIES	15	OFFICE
6	PRINCIPAL	16	ART ROOM
7	NURSE	17	SHOPS
8	MECHANICAL ROOM	18	HOME ECONOMICS
9	STAFF	19	CHANGE ROOM
10	GYMNASIUM	20	INSTRUCTOR

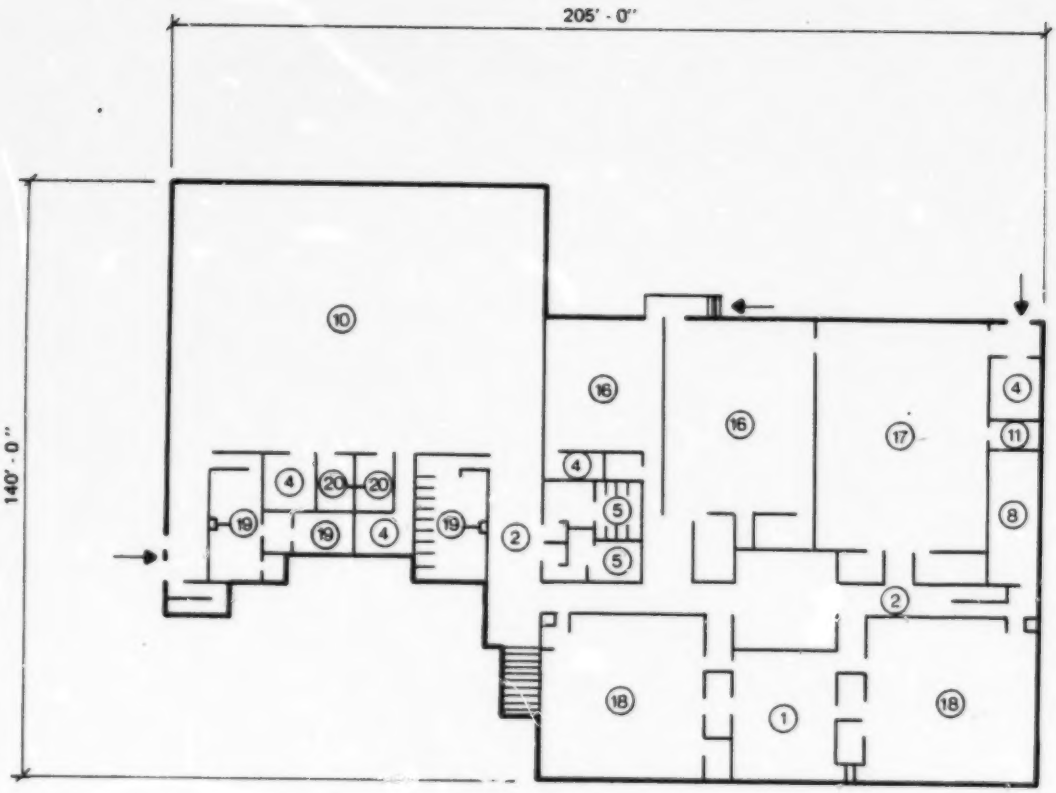
AREA = 61650 ft^2 (5730 m^2)

0 10 20 40

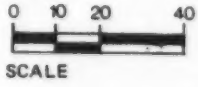
SCALE

ENERSCHOOL PROGRAM
SCOTT BATEMAN SCHOOL, THE PAS

FIGURE 20a



2ND FLOOR PLAN



ENERSCHOOL PROGRAM
SCOTT BATEMAN SCHOOL, THE PAS

FIGURE 20b

TABLE 43

SCOTT BATEMAN JUNIOR HIGH SCHOOL

SUMMARY OF RETROFIT OPTIONS

(LESS THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.3.1	Eliminate hold position on reset timers	200	200	1
5.3.5	Schedule exhaust fan switching			
5.3.7	Operating guideline for gym reset timers			
5.3.8	Reset boiler room 'stat			
5.3.11	Guideline for switching ceiling fans			
5.3.12	Lower gym thermostat setting			
5.3.13	Switch off loads at electrical breakers during summer			
5.3.14	Change time clock settings			
5.3.15	Adjust mixed air controllers			
5.3.16	Establish monitoring procedure			
5.3.17	Change time clock settings			
5.4.3	Turn off lights when area is vacant			
5.4.4	Use energy saving lamps when replacing			
5.4.10	Switch off lighting when not required			
5.4.11	Switch off lighting when not required			
5.4.12	Clean fixture lenses			
5.4.9	Change to switch arrangement	735	400	0.5

TABLE 44

SCOTT BATEMAN JUNIOR HIGH SCHOOL

SUMMARY OF RETROFIT OPTIONS

(GREATER THAN 5 YEAR SIMPLE PAYBACK)

ITEM	DESCRIPTION	IMPLEMENTATION COST ($/a)	COST SAVING ($/a)	PAYBACK PERIOD (YEARS)
5.3.9	Service boiler 15.6° (46°F)	250	250	1.0
5.3.10	Install ceiling fans	430	2,700	6.3
5.2.3	Repair and Replace Weatherstripping	1,250	250	5.0
5.4.5	Lighting reduction - woodworking	200	1,500	7.5
5.4.6	Lighting reduction - nutrition and clothing	310	2,400	7.7
5.4.7	Cycle Car Plugs	6,000	908	6.6
5.3.2.	Outdoor reset hot water heating	2,000	320	6.0
5.3.3.	Night setback	6,700	907	7.4
5.3.4	Shut off boiler above 60°F	400	100	4.0
5.3.10	Install ceiling fans	2,700	430	6.3

PROJECT OVERVIEW

At the start of the project the decision was made that the total costs of the project, including consultant fees, would be shared equally by Canada, Manitoba and the proponent. Consultant costs were pro rated based on the area of each school and the total area of all the schools retrofitted in that sector.

The consultants' costs for the total project were:

Winnipeg Schools	W.L. Wardrop	$ 81,000
32,316 m^2 = $\$2.51/m^2$		
Rural Schools	UMA	40,300
24,810 M^2 = $\$1.62/m^2$		
Northern Schools	Scouten Mitchell Sigurdson	50,000
20,505 m^2 = $\$2.44/m^2$		

An additional contract of $7,300 was also granted to W.L. Wardrop for the preparation of the Enerschool manual.

A budget was prepared based on area of the school and this was used for the initial estimate. Based on these figures an estimated simple payback period was calculated and this was used as a first approximation.

Following completion of the project the actual retrofit costs were tabulated and these figures, along with the estimated savings, were used to determine the actual estimated payback period. The actual payback period cannot be accurately determined until the buildings have been monitored for a period of time, which has been arbitrarily chosen as three years.

The approach will be to issue monitoring contracts to the original consultants and they will be responsible for reporting the energy consumption figures and making a yearly inspection visit to each facility. When corrected to a degree day basis, an accurate actual payback period can be calculated.

It is possible to calculate the estimated payback in a number of ways; e.g. minor vs. major, rural vs. urban vs. northern. This exercise will await the confirmation of the savings by the monitoring study. However, from the preliminary figures it is fairly obvious that school energy retrofits are an economically viable proposition and the project can be termed a success.